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The Engineer

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PUBLIC NOTICES

The Director - General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—
7550 STEEL SPRINGS FOR BUFFERS AND DRAW GEAR.
Tenders due on the 21st December, 1926.
Specifications and forms of Tender obtainable from the above at a fee of 5s. per set, which will not be returned. 4194

The Director - General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—
1. CIRCULATING WATER PUMPS, SCREENS and PUMP HOUSE EQUIPMENT, including DELIVERY and ERECTION in INDIA.
2. 11 COMPLETE TRACTION SUB-STATIONS and TRACK SECTIONING CABIN EQUIPMENTS, including DELIVERY and ERECTION in INDIA.
Tenders due on the 21st January, 1927, for No. 1, and on the 4th February, 1927, for No. 2.
Specifications and forms of Tender obtainable from the above at a fee of :—
ITEM No. 1.—10s. for the first three copies and 10s. for each further copy.
ITEM No. 2.—£2 for the first three copies and £1 for each further copy. 4195

Assistant Engineers (7) REQUIRED by the GOVERNMENT of NIGERIA for the PUBLIC WORKS DEPARTMENT for two tours of not less than 12 nor more than 18 months' service in the first instance. Subject to satisfactory service, the officers appointed will be eligible at the expiration of three years' service for confirmation in the permanent and pensionable establishment. Salary £480, rising to £920 a year. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, preferably between 25 and 30 years of age, must have passed the examination for A.M.I.C.E. or possess a degree in Civil Engineering recognised by the Institution as exempting from Parts "A" and "B" of the examination. They must have had proper technical training and preferably have had not less than two years' subsequent experience on large engineering or municipal works. Candidates possessing other civil engineering qualifications may apply.—Applications should be made at once by letter, stating age, qualifications and experience, also whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, quoting M/14485. 4188

Civil Engineer Required for the NIGERIAN RAILWAY (Capital Works), for two tours of 12 to 18 months' service, with possible extension. Salary £480, rising to £920 a year. Free quarters and passages and liberal leave on full salary. Outfit allowance of £60 on first appointment. Candidates, age 25-35, should have had constructional experience on recognised railways in the United Kingdom or abroad. Preference will be given to a man with a knowledge of track work, bridges and culverts. It is desirable they should have passed the examination to qualify for A.M.I.C.E. or hold equivalent qualifications.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, quoting M/14906. 4187

The Government of MADRAS REQUIRE an ASSISTANT EXECUTIVE ENGINEER for Cochin Harbour Works.
QUALIFICATIONS.—Age 25-35 years; degree in engineering of a recognised University of Great Britain or Ireland; three or four years' training under a Chartered Civil Engineer of standing with two or three years' further experience on public works, preferably harbour works; must be or become an Associate Member of the Institution of Civil Engineers.
Five years' agreement. Pay at the rate of Rs. 750-50-950 per mensem. Initial pay according to qualifications and experience. Free passage to India and return on satisfactory termination of agreement. Provident Fund. Strict medical examination.
Forms of application and further particulars may be obtained upon request by postcard from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 30th December, 1926. 4135

Port of Bristol Authority.
GRAIN HANDLING MACHINERY IN CONNECTION WITH THE EXTENSION OF THE ROYAL EDWARD DOCK, AVONMOUTH, AND THE CONSTRUCTION OF TWO GRANARIES; ALSO ADDITIONS TO EXISTING BANDS.
The Docks Committee are prepared to receive TENDERS for the above, which includes New Conveyors, Bands, Motors and Switchgear.
On and after Friday, the 10th day of December, 1926, copies of the specification and contract drawings can be obtained from the undersigned on production of a receipt showing that a deposit of £5 has been paid. ALL CHEQUES MUST BE MADE PAYABLE to the "PORT OF BRISTOL AUTHORITY" and forwarded to the General Manager and Secretary, Docks Office, 19, Queen-square, Bristol. The deposit will be returned to bona fide tenderers after the receipt of the Tender with all the prescribed documents and drawings.
Tenders must be enclosed in a sealed envelope and endorsed "Tender for Grain Handling Machinery," and addressed to the General Manager and Secretary of the Port of Bristol Authority, 19, Queen-square, Bristol, and must be delivered to him, accompanied by all the prescribed documents and drawings, before 10 a.m. on Monday, the 10th day of January, 1927.
The Docks Committee do not bind themselves to accept the lowest or any Tender.
THOMAS A. PEACE, Engineer.
Chief Engineer's Office,
Avonmouth Docks,
3rd December, 1926. 4140

The Madras and Southern MAHRATTA RAILWAY COMPANY, Limited, 25, Buckingham Palace-road, Westminster, S.W. 1, invite TENDERS for :—
METALS (comprising Aluminium, Antimony, Brass Rods and Sheets, Brass Tubing and Wire, Copper Ingots and Gauze, Copper Plates and Rods, Sheets, Tubing and Wire, Lead and Zinc Sheets, &c.).
Tenders are due in on Tuesday, 21st December, 1926, by 3 p.m. Tender forms obtainable at above address, fee One Guinea, which is not returnable.
The Directors do not bind themselves to accept the lowest or any Tender. 4168

PUBLIC NOTICES

The County of London Electric SUPPLY COMPANY, LIMITED.
BARKING POWER STATION EXTENSIONS, 1926.
JETTY AND PUMP HOUSE EXTENSION CONTRACT.
The County of London Electric Supply Co., Ltd., are prepared to receive TENDERS for the EXTENSION of the existing JETTY and PUMP HOUSE, CONSTRUCTION of BARGE BERTH, OUTLET CULVERTS OUTFALL, and relative WORKS at Barking Power Station.
The specification, schedule, form of Tender and other particulars can be obtained from Sir Alexander Gibb and Partners, Queen Anne's Lodge, London, S.W. 1, and drawings can be inspected at the same address. A deposit of £5 5s. will be charged for the documents, and this will be returned on receipt of a bona fide Tender by the date below mentioned.
Sealed Tenders, marked "Tender for Jetty and Pump House Contract, Barking Extensions," should be addressed to the undersigned and lodged at the registered office of the Company by Noon on the 4th January, 1927.
The Company do not bind themselves to accept the lowest or any Tender.
F. C. McQUOWN, Joint Manager and Secretary.
The County of London Electric Supply Co., Ltd.,
Moorgate-court, Moorgate-place, London, E.C. 2. 4169

The North British Aluminium COMPANY, LIMITED.
LOCHABER WATER POWER.
SPECIFICATIONS NOS. 100 AND 101.
The North British Aluminium Co., Ltd., is prepared to receive TENDERS for the CONSTRUCTION, DELIVERY and ERECTION at their Power House, near Fort William, Inverness-shire, of :—
(1) WATER TURBINES (Impulse Type) (Specification No. 100).
(2) DIRECT-CURRENT GENERATORS (Specification No. 101).
Persons desiring to Tender may obtain, on and after 11th December, 1926, from the Company's Offices, Adelaide House, King William-street, E.C., copies of the drawings, specifications, form of Tender, &c., upon production of evidence to the satisfaction of the Company of their ability to carry out such work. For this purpose the applicants must give details of the capacity and efficiency of the largest single units of plant of similar type which they have already constructed and also state the location of such plant.
Preference will be given to contractors on the King's Roll.
Sealed Tenders, endorsed "Lochaber Water Power, Specification No. —, Tender for ——," must be addressed to the SECRETARY and delivered at the Company's offices not later than 10 a.m. on Tuesday, February 1st, 1927.
The Company does not bind itself to accept the owest or any Tender. 4189

PUBLIC NOTICES

TO BUILDERS.
The Managers of the North Surrey District School, Anerley, S.E. 20, invite TENDERS from builders and contractors for the CARRYING OUT of certain ALTERATIONS at the School in providing new BATHROOMS, together with new HOT WATER INSTALLATIONS.
The drawings can be inspected at the School on application to the Superintendent, and forms of Tender, including conditions of contract and complete specification, may be obtained from me at 2, Staple Inn, W.C. 1, by sending a stamped (2d.), addressed foolscap envelope or wrapper.
Tenders must be on the form provided, and returned sealed and endorsed "Tender for Baths," addressed to the Managers, North Surrey District School, Anerley, S.E. 20, in time to reach there not later than Monday, 27th inst.
The Managers do not bind themselves to accept the lowest or any Tender. The acceptance of any Tender will be subject to the approval of the Minister of Health.
H. J. CHALDECOTT, Clerk to the Managers.
2, Staple Inn, London, W.C. 1,
1st December, 1926. 4182

Municipality of Colombo, CEYLON.
APPOINTMENT OF A FIRST GRADE ENGINEER.
The Colombo Municipal Council REQUIRE the SERVICES of a 1st GRADE ENGINEER.
Applicants must have had at least 10 years' practical engineering experience, including experience in Municipal Work and Practical Town Planning, and must have passed the A.M.I.C.E. qualifying examination.
The salary attached to the post is Rs. 12,000 a year, rising by annual increments of Rs. 480 to Rs. 15,000.
The officer appointed must provide himself with and maintain a motor car, for which he will receive an allowance of Rs. 1800 a year.
The selected candidate will be required to enter into an agreement to serve the Council for a period of three years. At the end of three years, if the officer has carried out his duties to the satisfaction of the Council, he will be appointed to the permanent staff, with leave and pension rights according to the Council's regulations.
Medical examination as to fitness for service in the East is required.
Free passage to Colombo, second class by mail steamer or first class by other steamer, will be provided, with half-pay during the voyage.
Application forms and further details can be obtained from the Council's London Agents, Messrs. JOHN POOK and CO., No. 68, Fenchurch-street, London, to whom candidates should forward their applications before December 21st, 1926.
Town Hall, Colombo,
30th October, 1926. 4128

PUBLIC NOTICES

Bombay, Baroda and Central INDIA RAILWAY.
CHIEF DRAUGHTSMAN FOR LOCOMOTIVE AND CARRIAGE DEPT.
REQUIRED for service in India, a CHIEF DRAUGHTSMAN, between 25 and 35 years of age, capable of dealing with Locomotive, Carriage and Wagon Drawing-office Work, who must have served an apprenticeship with a railway company or large locomotive engine builders, and subsequently have had experience in any up-to-date well-managed drawing-office. A general knowledge of works, design and arrangement of machinery is desirable.
Candidates must possess a good technical knowledge and must have undertaken a thorough course of instruction at an Engineering College or large Technical School, and must be capable of correctly calculating stresses in boilers, working parts of engines and machines, and in simple structural designs and girders. The selected candidate will also have to deal with the usual calculations of a locomotive drawing-office regarding tractive power, &c. &c.
Other things being equal, preference will be given to applicants who have been required to see work during manufacture.
TERMS.—A three years' agreement in the first instance, and service may be continued if satisfactory. Free 2nd class passage to India and return on satisfactory termination of services.
SALARY.—Rupees 575 to Rupees 650 per calendar month, according to qualifications.
The selected candidate will be required to pass a strict medical examination before appointment.
Applications (by letter only), giving full particulars of general and technical education and honours gained (if any), age, and whether married, and details of experience in chronological order, with dates, together with copies only of testimonials, must be addressed to the undersigned not later than 30th December, 1926.
S. G. S. YOUNG, Secretary.
Offices: The White Mansion,
91, Petty France, Westminster, S.W. 1,
7th December, 1926. 4192

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

ADVERTISERS Under Box No. 4002 Wish to THANK the numerous APPLICANTS, and would say that the POSITION is now FILLED. 4175 A

WANTED for India, ENGINEER SALESMAN, conversant with Air Compressing and Pneumatic Plant for Mining and Workshop use. Age not over 28. Must be single.—State fullest details of education, experience, and salary required, to Z.T. 270, c/o Deacon's Advertising Agency, Fenchurch-avenue, London, E.C. 3. 4181 A

WANTED, WORKS MANAGER for Old-established Locomotive Building Works, conversant with up-to-date methods of construction and works management.—Address, stating age, experience, salary required, &c., 4183, The Engineer Office. 4183 A

ASSISTANT CIVIL ENGINEER REQUIRED for New Port Works in East Africa, with experience of Marine Surveying. Salary £500 to £600 a year, according to qualifications. Two years' agreement. Applications, with full particulars of training and experience, to be sent.—Address, P2559, The Engineer Office. P2559 A

BLAST-FURNACE MANAGER, an ASSISTANT, REQUIRED. Must be competent, practical man, used to control of Hematite Blast-furnaces, with a thorough grasp of the process and used to handling men.—Apply, with full particulars as to age, qualifications, experience, and salary required, to SECRETARY, Consett Iron Company, Ltd., Consett, Co. Durham. 4099 A

CHIEF ENGINEER.—A Thoroughly Competent MAN is REQUIRED to Take Entire Charge of the Engineering Plant of an important Hotel in London.
A most comprehensive experience in all departments is essential, as the hotel possesses its own generating plant in addition to a complete equipment for meeting all the modern requirements of a large first-class hotel.
Write, stating age and full details of experience, and with copies of testimonials, Box 914, Dorlands, 14, Regent-street, S.W. 1. P2555 A

GENTLEMAN, of Good Appearance and Address, is REQUIRED for the Management of Sales Branch in Yorkshire and the North, of well-known Manufacturers and Distributors of Gas, Water, Steam, and Oil Pipe Line Requisites. A thorough knowledge of the area essential, and applicants should have general engineering and sales experience.—Address, stating age and all qualifications, 4161, The Engineer Office. 4161 A

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MACHINE TOOL DESIGNER.—An OPENING occurs for a First-class MACHINE TOOL DESIGNER of good education and broad views, who is capable of earning £1000 a year. Applications will be treated in strict confidence.
Address, P2540, The Engineer Office. P2540 A

REINFORCED CONCRETE SPECIALISTS REQUIRE a good SENIOR DESIGNER. Previous experience essential. State full particulars of experience with dates, age, and salary required.—Address, 4178, The Engineer Office. 4178 A

REQUIRED, ASSISTANT for Engineer's Office; accustomed to Calculating Quantities for Invoicing.—Write in confidence experience and salary required, to Box Z.E. 208, c/o Deacon's Advertising Agency, Fenchurch-avenue, E.C. 3. 4153 A

SALES ASSISTANT for Large Marine Engineering Works; must be first-class organiser with experience in Handling Agents, &c.—Address, P2568, The Engineer Office. P2568 A

THE PHŒNIX OIL and TRANSPORT CO., Ltd., has VACANCIES for a number of recent GRADUATES in the FACULTIES of ENGINEERING, MINING, CIVIL or MECHANICAL, for POSITIONS as PROBATIONERS in OILFIELD ENGINEERING in Roumania.
It is essential that applicants (who should not be over 25 years of age) should possess a B.Sc. Degree, preferably in Engineering.
Particulars may be obtained from the COMPANY'S OFFICES, 9/12, Fenchurch-buildings, Fenchurch-street, London, E.C. 3. 4123 A

TRAINED ENGINEER WANTED to Represent firm dealing in good second-hand machinery, chiefly woodworking machinery and power plant. State age, experience, and salary required.—X. X., 119, Coniston-road, Bromley, Kent. 4168 A

YOUNG ENGINEER, Education Public School or equivalent, sound general engineering training, for Sales Department of Engineering Business in India. Salary to commence about Rs. 500 month.—Write, giving fullest particulars education and training, to Box 691, Leathwait and Simmons, 34, Throgmorton-street, E.C. 2. P2553 A

WORKS CHEMIST.—A Modern GENERAL ENGINEERING FIRM REQUIRE the SERVICES of a capable and well-trained CHEMIST and METALLURGIST. Must be capable of taking entire charge of laboratories, including chemical and physical tests, experience on Ferrous, Non-ferrous and Alloy Steel Materials essential, and some knowledge of the Manufacture of Pig Iron an advantage. Applications, which will be treated in confidence, must state full details of experience and qualifications, age, and salary required.—Address, 4167, The Engineer Office. 4167 A

WORKS MANAGER WANTED for Large Marine Engineering Works, North-East Coast. Practical man with up-to-date methods of construction and works management required.—Address, stating age, salary, and full particulars, P2567, The Engineer Office. P2567 A

WANTED, DRAUGHTSMAN, Experienced in Pumping Machinery, with special knowledge of Turbine and Centrifugal Pumps. State salary required and experience, with names of previous employers (which will be treated in strict confidence).—Address, 3986, The Engineer Office. 3986 A

WANTED for Engineering Works in Lancashire, SENIOR DRAUGHTSMAN, with experience in the design of Lyniflow and Heat Extraction Steam Engines. Only experienced men need apply, stating age, experience, and salary required.—Address, 4177, The Engineer Office. 4177 A

WANTED in the Midlands, a DRAUGHTSMAN experienced in the design of Railway Carriage Bodies and Wagons. State experience, salary required, and when disengaged.—Address, 4182, The Engineer Office. 4182 A

CAPABLE GENERAL DRAUGHTSMAN REQUIRED for large London factory.—Address, stating age, experience, and salary required, 4170, The Engineer Office. 4170 A

DRAUGHTSMAN (Mechanical) REQUIRED After Christmas, Westminster office. State salary, experience, references.—Address, 4163, The Engineer Office. 4163 A

DRAUGHTSMAN WANTED, with Experience in designing and estimating quantities for large Conveying Plants.—Address, 4165, The Engineer Office. 4165 A

JIG AND TOOL DRAUGHTSMEN.—TWO or THREE first-class MEN REQUIRED. Those with experience in designing Tools for Making Intricate Machinery.—Address, stating age, experience, and salary required, 4185, The Engineer Office. 4185 A

JUNIOR DRAUGHTSMAN REQUIRED (London district). Experience in Pumping Machinery preferred. State age, salary, and experience.—Address, 4124, The Engineer Office. 4124 A

JUNIOR DRAUGHTSMAN REQUIRED, W. London district, General Engineering Works. State age, experience, and salary.—Address, P2560, The Engineer Office. P2560 A

LONDON FIRM of CONSTRUCTIONAL ENGINEERS REQUIRE DRAUGHTSMAN, able to design and estimate. Only those with the necessary experience need apply. State experience, age, and salary.—Address, 4152, The Engineer Office. 4152 A

REQUIRED IMMEDIATELY by Large Manufacturing Firm in the West, JUNIOR DRAUGHTSMAN.—Address, stating age, experience, and salary required, 4166, The Engineer Office. 4166 A

REQUIRED IMMEDIATELY, SEVERAL First-class DRAUGHTSMEN. Only those with experience in Steel Work and the design of Navy Industrial Buildings and good practical and theoretical qualifications need apply.—Address, stating age, experience, and salary required, 4179, The Engineer Office. 4179 A

CLERK REQUIRED for the Drawing-office of a large Firm of Engineers and Contractors. Must be capable of taking charge of filing, numbering and card indexing drawings, &c.—Address, stating age, experience, and salary required, 4180, The Engineer Office. 4180 A

WANTED, ASSISTANT FOUNDRY FOREMAN for High-class Bronze and Ironwork, experienced Machine and Plate Moulding.—Address, 4112, The Engineer Office. 4112 A

SITUATIONS WANTED

A COMMERCIAL ENGINEER (36), A.M.I.C.E., A.M.I.M.E., workshop, design, inspection and sales experience with power plant and machinery, REQUIRES POSITION as Sales Manager or Representative. Excellent business record.—Address, 4197, The Engineer Office. 4197 B

ADVERTISER, Age 41, DESIRES RE-ENGAGEMENT as Foundry Manager. Has had considerable experience in the manufacture of general engineering castings, special and vertically cast pipes. Last position 7½ years.—Address, P2542, The Engineer Office. P2542 B

SITUATIONS WANTED (continued)

B.SC. (1st Class Hons. Civ. Engr.), A.M. Inst. C.E., A.M.I. Mech. E., M.I. Struct. E., would like to OBTAIN a POST offering adequate return for hard work, energy, and initiative.—Address, P2570, The Engineer Office. P2570 B

CAMBRIDGE ENGINEERING GRADUATE (24), public school, D.O. and shops experience in well-known steam and hydraulic works, sound knowledge I.C. design, 1st class testimonials, SEEKS APPOINTMENT.—Address, P2563, The Engineer Office. P2563 B

CONTRACTOR'S AGENT of Proved Ability DISENGAGED. Many years' experience in civil engineering and reinforced concrete contracts, successful estimator, organiser and supervisor. Highest references.—Address, P2508, The Engineer Office. P2508 B

ELECTRICAL and MECHANICAL ENGINEER (27), with ten years' practical technical experience, at present engineer to chemical company, DESIRES APPOINTMENT as WORKS ENGINEER or SALES ENGINEER, at home or abroad.—Write, Box 691, Leathwait and Simmons, 34, Throgmorton-street, E.C. 2. P2554 B

ENGINEER (37), Shortly Disengaged, DESIRES POSITION as Works Manager or similar capacity, Automobile and general, wide experience.—Address, P2565, The Engineer Office. P2565 B

ENGINEER, with 20 Years' Experience, Marine and general engineering, also commercial experience, held responsible posts, DESIRES POSITION, home or abroad.—Address, P2585, The Engineer Office. P2505 B

EXPERIENCED ENGINEER (35), 1st Class B.O.T., wide knowledge of all kinds of ships and small craft, steam and internal combustion engines, all types of boilers, auxiliary machinery, electric light, pumping plants, and refrigeration; ex chief engineer 10,000-ton liner and Exec. Lt.-Comdr., R.N. (Temp.), ex assistant manager of large salvage firm, also ex assistant supt. of large firm of dry dock, slipway and general engineers, good organiser and disciplinarian, excellent credentials, DESIRES responsible POSITION.—Address, P2552, The Engineer Office. P2552 B

SITUATIONS WANTED (continued)

EXPERIENCED ESTIMATOR ENGINEER SEEKS ADVANCE. Cylinders, wharves, jetties, dock pumps, steel, timber, ferro-crete; lay-outs and designs.—Address, P2562, The Engineer Office. P2562 B

LOCO. and CARR. ENGINEER, 10 Years' Experience Indian railways, both loco. and traffic, 2½ years light railways in France, four years railway managing agents, experience including sale railway materials, power and rolling stock, good organiser and administrator, very keen business side railway work, REQUIRES POST in connection with railways. Excellent references, public school. Papers sent on request.—Address, P2558, The Engineer Office. P2558 B

MECHANICAL ENGINEER (33) DESIRES CHANGE, Works or Assistant Manager; 10 years' general engineering experience, chief drawing-office and assistant works manager. Energetic and good schemer.—Address, P2557, The Engineer Office. P2557 B

EXPERIENCED LADY TRACER SEEKS RE-ENGAGEMENT. Good references.
Address,
P2561, The Engineer Office. P2561 B

SMART Practical DRAUGHTSMAN (25), Experienced in metallurgical, coal washing, structural and mechanical work, L.C. and G. honours, met. and mech. eng., 4 yrs. shops, 4 yrs. D.O., DESIRES POST.—Address, P2571, The Engineer Office. P2571 B

PARTNERSHIPS

IF YOU ARE SEEKING
A PARTNER or PARTNERSHIP
or wish to buy or sell a
BUSINESS or WORKS
Write:
WHEATLEY KIRK, PRICE & CO.,
46, Watling Street,
London, E.C. 4.
Established over 75 years.

PARTNERSHIPS

ACTIVE DIRECTOR (or Sleeping) WANTED, to take controlling interest in small West Country Foundry (est. 79 years). Could obtain managing directorship or be trained.—" ACCOUNTANT," 23, Goldsmith-street, Exeter. P2544 C

AN ENGINEERING COMPANY in Cheshire, with LARGE MODERN WORKS thoroughly equipped on up-to-date lines, would LIKE to CONNECT with an ENGINEER with some capital at his disposal and preferable specialities to develop.—Address, 4190, The Engineer Office. 4190 C

PUBLIC WORKS CONTRACTOR, with £5000, WANTED as Active Director and Part Successor in a prosperous London Business.—Address, 4172, The Engineer Office. 4172 C

EDUCATIONAL

COACHING for INST. C.E. EXAMINATION. Personal or by correspondence.—To G. W. M. BOYCOTT, Assoc. M. Inst. C.E., 1, Orchard Drive, Blackheath, S.E. 3. 4150 E

CORRESPONDENCE COURSES for Inst. Civil Engineers, Inst. Mech. E., London Univ., and ALL ENGINEERING EXAMINATIONS, personally conducted by Mr. TREVOR W. PHILLIPS, B.Sc. (Honours), Eng., London, Assoc. M. Inst. C.E., Chartered Civil Engineer, M.R.S.I., F.R.S.A., &c. Excellent results at all Exams., comprising hundreds of successes. Courses may commence at any time.—Apply to Mr. TREVOR W. PHILLIPS, B.Sc. (Hons.), A.M.I.C.E., &c., 9/11, TRAFFORD CHAMBERS, 58, SOUTH JOHN-STREET, LIVERPOOL. Tel. No. Bank 1118.—London Office: 65, Chancery-lane, W.C. 2. Ex. E

DRAUGHTSMANSHIP.—A Qualified ENGINEER, with over 25 years' highly successful experience as a teacher of draughtsmanship, offers postal tuition by means of his simplified home-study Course. The instruction is specially devised to suit the needs of individual students, and COACHING for PROFESSIONAL EXAMINATIONS is a speciality. Low fees. Booklet F free on request.—Mr. PERCY PITMAN, M.I. Mech. E., 25, Victoria-street, London, S.W. 1 (Established 1894). Ex.

For continuation of Small Advertisements see page 3.

ELLISON CONTROL GEAR
for Automatic Protection of
Electric Motors and Circuits

You can now obtain circuit-breaker protective and starting gear for small and medium size motors, and secure true overload protection, at prices which are low for good quality switchgear.
Reduced prices are made possible by the quantity development of Ellison "No. 0" size Oil Breakers and Starters.

This range of gear includes :—

1. Circuit Breakers with all usual automatic releases.
2. "Straight-on" Motor Starters: being circuit breakers with Double-valve Time Lags.
3. Stardelta Starters with all the advantages of circuit breakers.
4. Auto-transformer Starters with all the advantages of circuit breakers.
5. Starter Panels for slip-ring motors.
6. Distribution Boards for Power and Lighting circuits.

You can obtain this switchgear for your motors, direct from Ellison's or through the leading motor makers.
Write for particulars of "No. 0" gear.

GEORGE ELLISON
Makers of Electric Control and Switchgear.
Works: PERRY BARR, BIRMINGHAM.
TRADE MARK

A Seven-Day Journal

Industry and Local Rates.

THE Federation of Britsh Industries recently memorialised the Prime Minister on the subject of local rates and taxes and the burden which they impose on industry. The subject is one which for some time has engaged the anxious consideration of many firms throughout the country. In Manchester this week, as our correspondent in that city records elsewhere in this issue, the local Chamber of Commerce took up the matter with the civic authorities. The discussion is to be continued. Elsewhere similar steps designed to secure alleviation are being contemplated. Of all the sufferers from high local rates and taxes, few can feel the burden more severely than the railway companies. In 1900 the companies paid in local rates £3,633,531, and in 1913 £4,767,780. In 1924 the sum increased to £7,654,733, or more than double what it was in 1900. In addition, in 1924 the companies paid £614,946 in local rates on their canals, docks, harbours, hotels and electric power houses. The total sum paid was therefore £8,269,679, the equivalent of 10s. 0½d. in the pound on the ordinary dividend distributed. On the net receipts earned in 1924 the local rates amount to the equivalent of 20·9 per cent., whereas in 1913 the figure was only 10·8 per cent. The railway companies argue that the services rendered them by local authorities are small compared with the sum paid out in local rates, and that there should be a return to the old principle of rating under which payment was proportional to the benefits received. Sir Hugh Bell, discussing the matter, suggested that the public demand for free libraries, free parks and other free services rendered it impossible to ease the burden of local rates. It was not realised, as it should be, that in the long run the burden fell principally upon wages. Mr. G. C. Vyle, President of the Association of British Chambers of Commerce, characterised the burden as a crushing one, and said that the only way to deal with it was for those in control of local industry and commerce to find half-a-dozen public-spirited men to go into the local councils and deal with the rates at the fountain head.

The Eight Hours' Day in France.

As the French were the first to adopt legislation imposing an eight hours' working day immediately after the Armistice, they considered that they were morally bound to confirm the Washington Convention. Notwithstanding the allegations that this limitation of working hours has had a disastrous effect upon the economical situation in France, mainly through the necessity of importing foreign labour, it is understood that the Senate felt it a duty to approve of the international agreement when it came up for debate last week. So much opposition has been raised against the measure that the Senate seems disposed to shelve it as long as possible. All classes of the commercial and industrial communities in France are agitating for a repeal, or at least a modification of the existing legislation, as offering the only means of enabling the country to recover its prosperity. The Confédération Générale du Travail is, of course, opposed to any change, but its influence has waned considerably of late years, and the fate of the eight hours' working day principle will be decided irrespectively of what the men's union is claiming as an intangible principle. During the debate in the Senate it was affirmed that France could not accept the terms of the Washington Convention unless other countries undertook to adopt the eight hour working day and enforce its application, particularly Germany, Italy, and Switzerland. As some countries have definitely abandoned a hard-and-fast labour restriction, it seems highly probable that the Washington agreement will be held up until the situation in Europe becomes more settled.

Telephones.

A PAPER of considerable value to telephone engineers was read a few days ago before the Institution of Electrical Engineers, by Mr. G. F. O'Dell, the title being "An Outline of the Trunking Aspect of Automatic Telephones." Referring to the fiftieth anniversary of the telephone celebrated at the Institution of Electrical Engineers on June 24th, Mr. O'Dell said that in the wonder and admiration at the magnitude of the achievement that had been revived by the anniversary, there was little recognition of the fact that the telephone would have remained scarcely more than a wonder, and of little practical use, had it not been for later inventions, which made possible the rapid connection of one telephone circuit with another and the establishment of a large number of simultaneous connections. In many quarters those matters were assumed to be natural developments of the original telephone, but as a matter of fact, the subsequent work was of only slightly less importance than that of Alexander Graham Bell. Soon after the invention of the telephone it became apparent that if the invention was to be of real value, arrangements would have to be made to put various subscribers in communication with one another at will. When telephones were in the same building or, at any rate, very close together, that might be done by means of inter-communication circuits, but in the general case the telephones were connected to control points, called exchanges, the situation and size of which were determined chiefly by economic considerations. The exchanges themselves were also connected with one another by junction lines. In the larger exchanges it was generally found that only a small proportion of the subscribers wished to use their telphones at any one time, and it was probably due to the fact that engineers had taken advantage of that circumstance that telephony on a large scale had become practicable. At any rate, the economics of the industry would have been vastly different if the average subscriber had been a large user of the telephone.

British and American Motor Cars.

Two items of news concerning the motor car industry on opposite sides of the globe which have been published this week may perhaps not inappropriately be recorded side by side. In the first place it has been announced and officially confirmed that an English firm, Morris Motors, Ltd., has received an order from a Melbourne distributing house for over 10,000 motor cars and lorries to be supplied during the coming year. The value of the contract is stated to be round about £3,000,000, the largest sum, it is said, ever involved in a single motor car contract placed with a British manufacturer by an overseas customer. The cars, it is stated, will be partly of the "Colonial" type, expressly designed for use in rough country, and partly of the standard type for city use. In addition, the order includes a considerable number of commercial vans. It is said that more than half of the business represented by the order went last year to the United States. The second item of news is the announcement that, whereas two years ago the sales of Ford cars totalled nearly two millions in the twelve months as compared with about 1,300,000 cars sold by all the other United States motor car makers, the Ford sales for the first six months of this year were about 859,000, as compared with nearly 1,500,000 cars sold by the remainder of the manufacturers. The interpretation placed by some on these figures is that the wave of prosperity in the United States has caused the public to turn away from the low-priced car to something of a superior make. Mr. Ford's five-day week plan, it would appear, is not meeting with complete approval from all his workpeople. A considerable nun ber of them, it seems, are working less than five days a week and are drawing proportionately reduced wages. These two items of news, taken together, are distinctly encouraging to British motor car manufacturers in their efforts to extend their overseas trade.

The Naworth Level Crossing Accident.

THE level crossing at Naworth, near Carlisle, where eight occupants of a motor vehicle and the gateman were killed in a collision with a train on August 30th last, was sanctioned in 1829 and opened in July, 1836. That date was before the passage of legislation relating to railways crossing roadways and before the Government inspection of railways was authorised. Further, whilst the Act of 1889 ordered the compulsory interlocking of points on passenger lines with the signals, it said nothing about level crossing gates. The protection at Naworth was in many respects deficient, but the report of Lieutenant-Colonel Mount on the accident, issued on Monday, December 6th, casts no blame upon the railway company, nor does it find any fault with the regulations for working the crossing laid down for the gatekeeper's guidance. There were three "simple common-sense and important duties" for that man to perform, but he failed in them all—he omitted to inspect the block indicators to see if a train was approaching; to put his signals to "danger" before opening the gates; and to open the further gate before the nearer one. Yet the man was given an excellent character. He had, however, certain station duties to perform and there was a persistent blowing of the horn of the motor "to get the level crossing gates open," and they may presumably have had "a psychological effect, disturbing attention and tending to hasty action." It is recommended that the equipment at the crossing should be brought into line with modern practice; that is, that simultaneously acting gates should be provided and that they should be interlocked with the signals.

Aircraft-Carrier Design.

IT is understood that the cruisers Courageous and Glorious, which are being rebuilt as aircraft carriers, will, on completion, resemble the Furious in the arrangement of flight decks and internal fittings, but that instead of the horizontal smoke ducts with which the latter is fitted they will have an upright funnel on the extreme starboard side, as in the Hermes. Experience with the Hermes and the Eagle is said to have shown that the smoke and hot gases from the funnels of these ships do not seriously incommode the pilots of machines landing on the deck, while the vertical uptakes are more conducive to steaming efficiency than the lateral ducts by which the products of combustion are discharged overside in the Furious and the Argus. It is noticeable that all the latest foreign aircraft carriers have vertical funnels. In the American ships Lexington and Saratoga the boiler uptakes are led into a single huge casing which is over 100ft. in length and 20ft. in width, but as this huge chimney is well over on the starboard side the greater part of the deck is left free for landing operations. In the Japanese carrier Hosho the three small funnels at the side are hinged to lie horizontally outward from the hull when flying is in progress, while in the French Béarn the single funnel is mounted in a sponson. The Japanese Admiralty is said to be considering the plans of a 28-knot aircraft carrier to be propelled by Diesel engines, the advantages of which for this class of vessel are obvious. For the moment, however, H.M.S. Hermes holds the field as the most successful carrier of moderate dimensions which has been evolved.

New Blue Star Liners.

THE new Blue Star liner Avelona, which was successfully launched at the Clydebank Yard of John Brown and Co., Ltd., on Monday last, December 6th, is the fourth vessel to be launched of the five new liners which are shortly to be added to the fleet of the Blue Star Line, Ltd., for its services between London and South America. Her sister ship, the Avila, was launched at Clydebank in September last and is now being fitted out. Two sister ships have been built and launched by Cammell Laird and Co., Ltd., at Birkenhead, and a third is on the stocks at that yard. All the ships are designed for a speed of 16 knots and have a loaded displacement of about 14,000 tons. The Almeda, the first of the vessels to be completed by Cammell Laird and Co., returned to Liverpool on Thursday, December 2nd, after carrying out successful trials on the Clyde, and is expected at Tilbury before the end of the month. She is a 510ft. vessel with a breadth moulded of 68ft. and a depth moulded of 37ft. 3in. Her propelling machinery comprises a twin-screw arrangement of Parsons single reduction geared turbines, which have been constructed by the builders. The Almeda is equipped for carrying refrigerated cargo and she has *de luxe* accommodation for 180 first-class passengers.

Salvage Operations at Scapa Flow.

SOME progress, we understand, has been made by Cox and Danks, Ltd., towards the salving of the upturned and nearly totally submerged ex-German battle-cruiser Moltke, which lies in about 70ft. of water in Scapa Flow, not far from the Hindenburg. The plan adopted for this vessel is that of introducing compressed air into the upturned hull and thereby driving out the imprisoned water. Naturally, work has been intermittent on account of the storms experienced at this time of the year. About a week ago, however, the vessel was raised several feet until a length of hull of about 300ft. with a height of about 12ft. was visible. Previously only about 40ft. of the hull were to be seen even at the lowest tide. When the hull has been sufficiently raised efforts will be made to cut away all impediments so that the wreck can be towed into shallower water for the salvage operations proper. Meanwhile the lifting docks which were used on the Hindenburg have been overhauled and the lifting gear rearranged to increase their steadying effect should they be required in course of the present operations.

London Bridges.

THE report of the Royal Commission on Cross-river Traffic in London, a body appointed as recently as last July, was issued to the public on Wednesday of this week. It outlines schemes for improving the cross-Thames traffic facilities, which, if carried out in full, would involve an estimated expenditure of £27,500,000. The Commissioners recommend the retention of Waterloo Bridge, underpinned and rebuilt where necessary and widened on the roadway to 35ft. They are against the construction of the proposed St. Paul's Bridge, but recommend the building of a "Ludgate" Bridge alongside the existing Blackfriars railway bridge. This bridge would have a width of 70ft. to 75ft. and would have high-level approaches which on the north side would extend as far as Holborn Viaduct. A still more ambitious scheme advocated by the Commissioners contemplates the building of a double-deck steel bridge at Charing Cross to carry six tracks of railway on the lower deck and a 60ft. roadway with two 15ft. footways on the upper. This bridge would replace the existing Charing Cross railway bridge, which with Charing Cross Station would be demolished. A new station would be built somewhat to the east of the present one. The roadway would be carried at a high level across the Strand and would reach ground level near the Cavell statue. On the south side the roadway would pass Waterloo Station at platform level and then descend to ground level by way of two ramps, each 75ft. wide. Among other schemes recommended by the Commissioners is the Dartford-Purfleet Tunnel, the construction of which has been advocated for some time past. The estimated cost of the Charing Cross Bridge scheme is £7,500,000 and of the Ludgate Bridge scheme £3,000,000. The cost of constructing the Dartford-Purfleet Tunnel is placed at £2,950,000 and of reconstructing Waterloo Bridge at £860,000.

Main Line Railway Electrification.

By Sir PHILIP DAWSON, M. Inst. C.E., &c., Consulting Engineer, and
S. PARKER SMITH, D.Sc., M.I.E.E., Professor of Electrical Engineering, Royal Technical College, Glasgow.

No. XVI.—U.S.A.: NORTH-EASTERN STATES.*

C.—PENNSYLVANIA RAILROAD (NEW YORK TERMINUS).†

1. General.

Until 1902 the Pennsylvania Railroad, in common with other roads on the mainland, had no direct rail connection with Manhattan Island. All passengers were conveyed across the Hudson River by ferry, while goods and freight were transported by car-floats to various connecting points in Manhattan, Brooklyn and Port Morris. The railway company was desirous of establishing a direct rail connection with the borough, especially as it had acquired control of the Long Island Railroad, which was also without city connection. The scheme undertaken in 1902 was to construct a large passenger station—the Pennsylvania terminus—on Manhattan Island and connect it by tunnels under the Hudson and East Rivers with Jersey City and Long Island city respectively. The scheme was completed in 1911, allowing the main line passenger trains of the Pa.R.R. and the multiple-unit suburban trains of the L.I.R.R. to enter Manhattan Borough. The completed arrangement is shown in the plan in Fig. 2 *ante*. The final step was the construction of the Hell Gate Bridge, which allows N.Y.N.H.H.R.R. trains from New England to be run through to the South and West *viâ* Long Island and the Pennsylvania terminus.

As will be seen from Fig. 2, the electrified zone begins at Manhattan transfer, near Harrison, N.J., where a double-tracked line branches off from the original main line to the Jersey City terminal. At Manhattan Transfer, trains intended for the Manhattan terminus are stopped, and an electric locomotive substituted for the steam engine. Such trains are then hauled through tubular tunnels to the Pennsylvania terminus, which occupies the space between 7th and 9th Avenues and 31st and 33rd Streets. The line, now four-tracked to accommodate the heavy suburban traffic of the L.I.R.R., runs thence under the East River to Sunnyside Yard on Long Island. The route length from the Transfer to Sunnyside Yard is 23 kiloms., representing 151 track kilometres, including lines in the stations—34 kiloms.

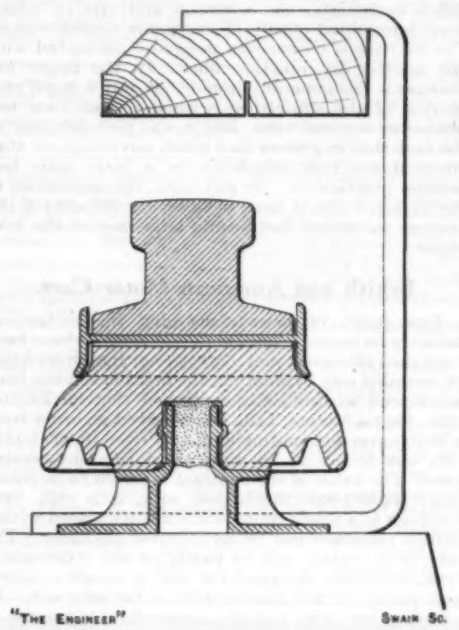


FIG. 8—THIRD RAIL, PENNA. R.R., NEW YORK

at Pennsylvania terminus and 58 kiloms. at Sunnyside Yard.

Power is developed at a special steam station at Long Island City, on the bank of the East River. This station also serves the L.I.R.R. Four sub-stations, as listed in Table VIII., are fed with three-phase energy at 11,000 volts, 25 periods, and in turn supply the third rail at 650 volts direct current.

Table VIII.—*Sub-stations, Pa.R.R. (New York Terminal).*

Sub-station.	Number of syn. converter sets.	Capacity of sets, kw.
Harrison	3	3,000
	1	4,000
Hackensack	3	2,000
Penna. Station	3	2,000
	1	4,000
Sunnyside Yard	3	2,000
	1	4,000

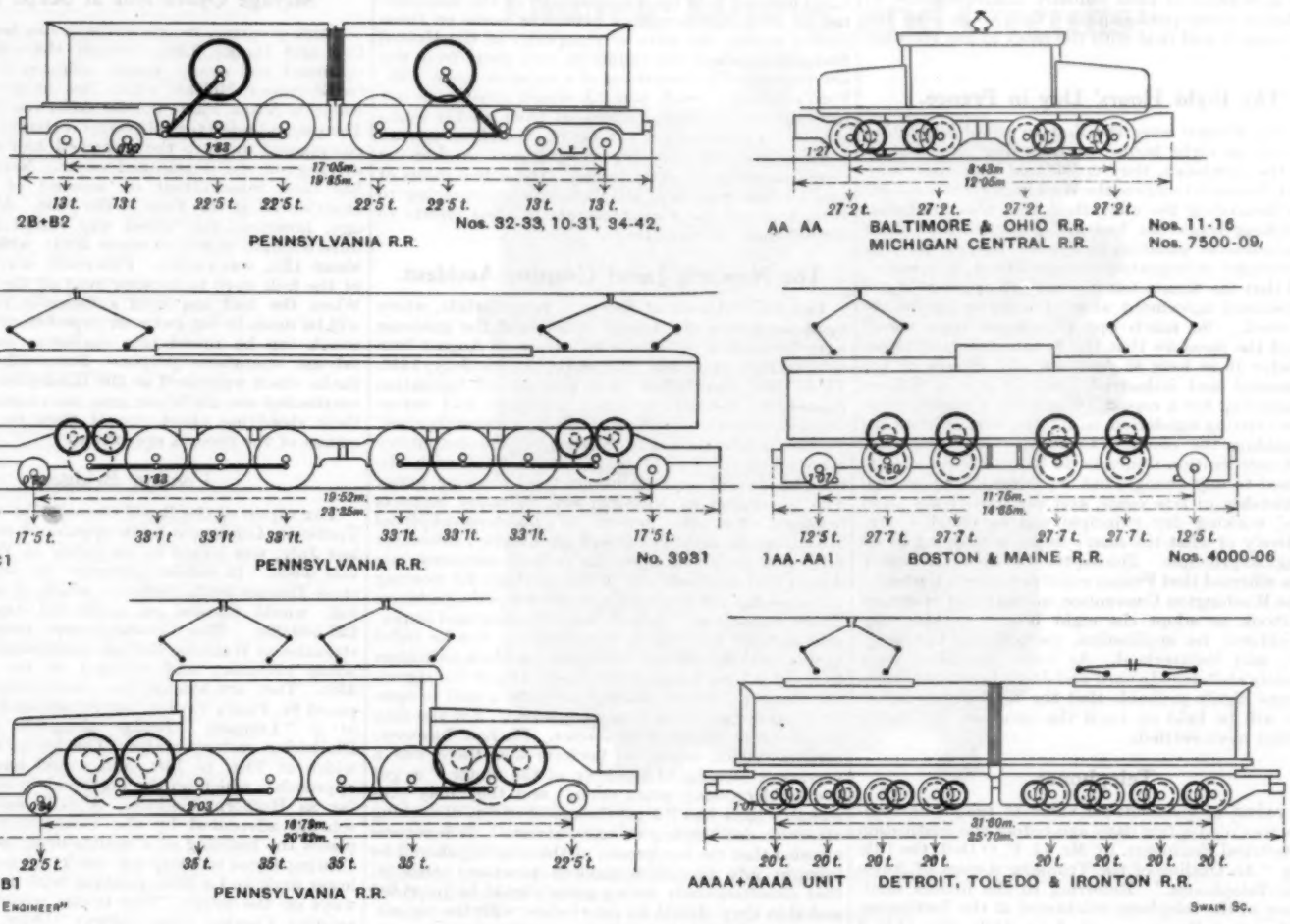
Third Rail.—This is of heavy section to obviate the necessity for feeders. The weight is 75 kilos. per metre, and the resistivity eight times that of copper. In the tunnels the rail is carried on robust porcelain insulators, as shown in Fig. 8. Care is taken to avoid electrolysis.

Locomotives.—In 1905 the Pa. R.R. Company constructed at its Altoona works two experimental locomotives of AA — AA type, one with motors geared to the axles, the other with a flexible gearless drive. At high speeds these engines were found to produce dangerous oscillations in a lateral direction. Investigation suggested that an arrangement analogous to that adopted with steam locomotives would give satisfactory running, *i.e.*, the centre of gravity should be high; the non-spring-borne weight should be a minimum; the axle arrangement should be unsymmetrical; and pony axles should be employed.

Numerous experiments made on both direct-current and alternating-current locomotives of a number of types of drive led to the development of two new locomotives, Nos. 3998 and 3999 (now Nos. 32 and 33) for 600 volts direct-current operation. The objects fulfilled were to obtain a high centre of gravity and to reduce the non-spring-borne weight. The traction motors are placed in the cabs and operate the driving axles through side-rods, jack-axles and coupling-rods. Each locomotive comprises two identical articulated units, the wheel arrangement of the whole being 2 B + B 2. Each unit carries a single 1000 horse-power motor in the cab. A diagram of the locomotives is shown in Fig. 9 and main data are given in Table III. *ante*. The motor has ten main poles and weighs 17 tons; the armature diameter is 142 cm., and the air gap is 6·3 mm. The armatures are so mounted that they will slip on the shafts should the motor current exceed 4000 ampères. Series-parallel and shunted-field speed control gives four economical running connections.

The two locomotives described above gave satisfactory results. The Pa. Company therefore ordered twenty-two others (Nos. 10–31) of similar construction, except for an increase in size of the driving wheels and a re-design of the jack axle frame. These were placed in service in 1910. A further nine locomotives, Nos. 34–42, were constructed in 1911. Data are given in Table III. *ante* and in Fig. 9.

Locomotive maintenance and inspection is centralised at Sunnyside Yard.



FIGS. 9 AND 10—ELECTRIC LOCOMOTIVES

2. Results of Electrification.

(*a*) *General.*—The limited zone of electrification and the high standard of maintenance of the Pa. R.R. Company have led to a satisfactory service. Of the thirty-three locomotives in commission, about thirty are in actual service at a time, three of these being occupied in shunting, &c., at Sunnyside Yard. On certain days of particularly heavy traffic, thirty-one locomotives may be operating. The mean annual travel of a locomotive is about 77,000 kiloms. This is

* Nos. I., II. and III. (Switzerland) appeared June 6th, 13th and 20th, 1924; Nos. IV. and IV.A (Scandinavia) appeared January 23rd and February 6th, 1925; Nos. V. and VI. (Germany) appeared June 5th and 12th, 1925; Nos. VII. and VIII. (Austria) appeared August 21st and 28th, 1925; Nos. IX. and X. (France) appeared October 2nd and 23rd, 1925; Nos. XI. and XII. (U.S.A., North-Western States) appeared February 12th and 26th, 1926; No. XIII. (U.S.A., South-Eastern States) appeared March 26th, 1926; and Nos. XIV. and XV. (U.S.A., North-Eastern States) appeared November 26th and December 3rd, 1926.

† General particulars of this and the other lines dealt with in this series of articles are given in Table II. *ante*.

low, owing to the short runs made, but the service is, nevertheless, severe, as it involves a large number of starts on gradients or curves. The absence of long runs at high speeds appears to be favourable to the life of the side rod bearings.

D.—PENNSYLVANIA RAILROAD (PHILADELPHIA TERMINUS).

1. GENERAL.

The Broad-street terminus of the Pa. R.R. has sixteen tracks, which narrow down to six at the main signal tower, increasing thereafter to nine tracks. Through this "bottle-neck" 600 trains per day are controlled, with fifty passing the signal tower during the peak load from 5 p.m. to 6 p.m. The station was originally designed to accommodate 160 trains per day. The increased capacity has been obtained principally by the electrification decided upon in 1910, and put into service in 1915. Five suburban routes are now operated electrically out of Broad-street, the Paoli and Chestnut Hill lines carrying the heaviest traffic.

The initial suburban electrification was intended as an important extension to the New York main line—Fig. 11. The single-phase system at 11,000 volts, 25 cycles, was therefore chosen.

The Broad-street–Bryn Mawr–Paoli line is 32·3 kiloms. in length, with four tracks, making a track

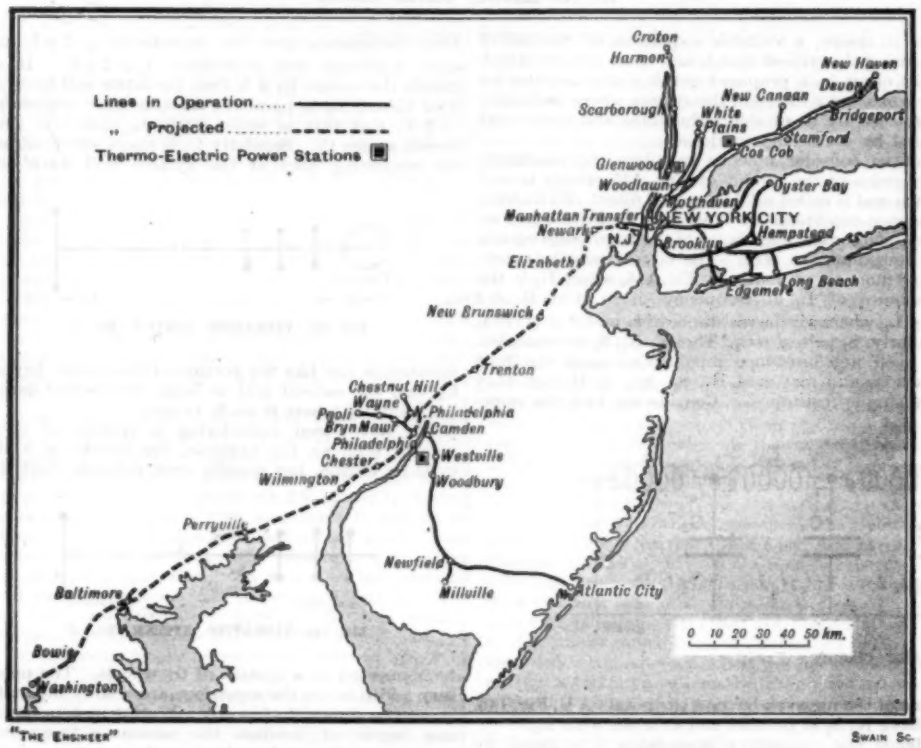


FIG. 11—NORTH-EASTERN STATES, ELECTRIFIED RAILWAYS

length electrified of 151 kiloms. The maximum gradient is 15 °/₀₀, the average distance between stations 1·6 kiloms.; the service is wholly suburban.

The Chestnut Hill line, 16 kiloms., and its branch, Allen-lane–Whitemarsh, 10 kiloms., are of similar characteristics.

Power is purchased from the Philadelphia Electric Company. The Paoli line and Chestnut Hill line each take a phase from the two-phase side of Scott-connected transformers connected to the power-house three-phase supply. Two synchronous condensers are run to increase the power factor for tariff reasons. The sub-stations are tabulated in Table IX.:—

TABLE IX.—*Sub-stations, Pa. R.R. (Philadelphia Terminus).*

Sub-station.	Number of transformers.	Capacity of transformers. kVA.
West Philadelphia	2	3000
	2	2000
Bryn Mawr	2	2000
Paoli	2	2000
North Philadelphia ..	2	3000
Allen Lane	2	3000

The trains, which are composed entirely of motor coaches, their number varying between two and nine, are equipped with single-phase commutator motors.

The electrification has given greater service flexibility at the terminus, eliminated smoke to a large extent, reduced space restriction, and switching operations, and has shown itself satisfactory.

2. EXPERIMENTAL LOCOMOTIVES.

In view of projected programmes of main line electrification, the Pa. R.R. Company has for some years undertaken the study of experimental locomotives on the Paoli electrification at Philadelphia.

The scheme of locomotive construction laid down was as follows:—

(1) To obtain a locomotive as powerful as the track conditions allow.

(2) To design robust apparatus for the locomotive for economical maintenance.

(3) To obtain a large ratio of spring-borne to total weight.

(4) To obtain a centre of gravity as high as possible above the rail level.

The 1 C — C 1 locomotive constructed with this scheme in view is shown in Fig. 9, and main data are given in Table III. *ante*. A single cabin rests on two trucks, each comprising three driving axles and a Bissel truck. On the truck chassis a pair of three-phase induction motors are geared on each side to a spring (cushion) gear wheel on a jack axle. The latter is coupled to the driving axles by horizontal coupling-rods. Each truck chassis provides a three-point suspension for the cab. The cushion gears have helical springs in their rims with an initial tension such that they will not come into play until the torque exceeds that required to produce a tractive effort equal to 25 per cent. of the adhesive weight. The remainder of the apparatus is grouped in the cabin, which is 22·0 m. long, and weighs about 82 tons complete, making the centre of gravity sufficiently high in spite of the low position of the motors. The cabin rests on each truck by a pivot situated between the first and second coupled axles, and by sliding plate bearings, laterally spring loaded, between the second and third coupled axles. The two trucks are articulated.

In placing the control gear in the cab the following conditions were observed:—

(1) Compactness of apparatus to keep the length of the locomotive as small as possible.

(2) Equal distribution of weight on each side of the longitudinal and transverse axes of the locomotive.

(3) Grouping together of heavy gear near the centre of gravity of the cab to reduce the tendency to parasitic movements.

(4) Preservation of sufficient ventilating space.

(5) Provision for easy dismantling and re-assembly of any piece of apparatus.

(6) Grouping to reduce the length of interconnecting cables.

(7) Grouping of rotary apparatus and all main circuit gear in the central compartment.

(8) Reservation of a free longitudinal passage at each side of the locomotive.

A single transformer, feeding the one-phase side of a synchronous phase converter, is used. Speed control is obtained by cascade control and the use of liquid rheostats. A more recent design is that shown also in Fig. 9, with a 1 B B 1 wheel arrangement. Three locomotives to this design have been built, viz., one single-phase engine for goods traffic at Philadelphia, and two for experimental passenger traffic on the New York terminal direct-current electrification. Each locomotive weighs 180 tons. The single-phase locomotive is equipped with four 815 horse-power motors—one-hour rating—two to each jack shaft. The connection between motors and jack shaft is made by means of pinions and flexible gears. The parts of the direct-current and single-phase motors have been made as far as possible identical. Main data are given in Table III. *ante*.

E.—BALTIMORE AND OHIO RAILROAD.

The Baltimore Belt Line electrification of the B. and O. R.R. is the pioneer installation of electric haulage at a steam road terminus, mainly for the elimination of smoke and fire risk in a long tunnel. Electric locomotives haul complete trains, including steam locomotives, through the tunnel up the ruling gradient, returning light. Both freight and passenger trains are so hauled.

The 650-volt direct-current third-rail system is used, although several other methods of current collection were previously tried. Power is obtained from the company's own station supplemented by a private supply concern.

F.—GRAND TRUNK RAILWAY (ST. CLAIR TUNNEL).

This is an example of a special tunnel electrification. The St. Clair tunnel, under the St. Clair River between Sarnia, Ont., and Port Huron, Mich., has heavy gradients of 2 °/₀ in each direction, and its operation with steam involved danger, owing to smoke. Since 1908 passenger and freight trains have been hauled through the tunnel by electric locomotives, the steam locomotives being taken off the trains before entering the tunnel. The single-phase system is used at 3300 volts, 25 cycles, with overhead conductor.

G.—MICHIGAN CENTRAL RAILROAD (DETROIT RIVER TUNNEL).

As in the case of the Grand Trunk Railway, this electrification comprises a short tunnel under the Detroit River between Windsor, Ont., and Detroit, Mich. The tunnel is double-tracked, with a 2 °/₀ gradient to westbound traffic and 1·5 °/₀ to eastbound traffic. The length is 2¼ kiloms. Since locomotive divisions are arranged to terminate on each side of the tunnel, the steam locomotives are replaced with electric locomotives on the trains, before passing through the tunnel. The direct-current third-rail system at 650 volts is employed.

H.—BOSTON AND MAINE RAILROAD (HOOSAC TUNNEL)

The Hoosac tunnel, on the main Boston–Albany route of the B. and M.R.R., pierces the Berkshire Hills in western Massachusetts. The tunnel is 8 kiloms. in length, with double track and 0·5 °/₀ gradients between the portals and the central shaft to provide drainage for the seepage water. The electrified zone extends between North Adams and Hoosac Tunnel Station, a distance of 13 kiloms.

The reasons for electrification lay in the congestion which occurred with steam haulage on account of smoke and exhaust gases. Complete trains, with the steam locomotive running light, are hauled through the tunnel. The locomotives are operated on single-phase energy at 11,000 volts, 25 cycles, on an overhead trolley line. Power was originally obtained from the Zylonite steam plant situated on the Hoosac River, near the west portal of the tunnel; energy is now purchased in bulk.

Main locomotive data for the B. and O.R.R., the M.C.R.R., and the B. and M.R.R. are given in Table III. *ante* and Fig. 10.

J.—DETROIT, TOLEDO AND IRONTON RAILROAD.

The first step in the electrification of the Detroit, Toledo and Ironton Railroad, a freight road controlled by the Ford Motor Company, is a 21-kilom. double-track experimental section. Power is supplied from the Ford company's River Rouge station by a 150-kilovolt transmission line. The single-phase contact line is fed at 23 kilovolts at 25 cycles. The motor generator system is used on the locomotives. The first experimental locomotive comprises two coupled units, capable of developing a maximum of 5000 horse-power at 27·5 kiloms. per hour. The normal one-hour rating is 4200 horse-power. Each unit is arranged for double-ended operation, so that a single locomotive may consist of one, two or more units, as desired. Each unit weighs 154 tons, all of which is adhesive. The advantages of this type of locomotive comprise the use of alternating-current transmission; the rugged and standardised direct-current series motor giving maximum space and weight efficiency; flexible speed control without rheostats; and high line power factor. On each locomotive unit there is a single transformer feeding a synchronous single-phase motor/direct-current generator set, the latter being in turn connected to eight nose-suspended direct-current series traction motors. The motors are connected permanently in parallel, their terminal voltage being varied by field control of the main generator. Regenerative braking is easily obtained. The ratings of the various parts of the locomotive are as follows:—

Transformer.—2000 kilovolt-ampères, single-phase, 25-cycle, 22,000 or 11,000/1250 volts.

Motor Generator.—Motor, 2100 horse-power, four-pole. Generator, 1500 kilowatts, 600 volts, 2500 ampères at 750 revolutions per minute, with 75-kilowatt, 125-volt direct-current main exciter, and 25-kilowatt regenerative exciter.

The 75-kilowatt main exciter supplies the motor field, generator field, regenerative exciter field, and all auxiliary motors. The 25-kilowatt exciter supplies the traction motor fields during regeneration and during high-speed motoring.

Traction Motors.—225 horse-power, 600-volt, with cushion gears on each side, ratio 22/98. The motors are connected in the usual series arrangement up to

a speed of 27·5 kiloms. per hour, after which they are separately excited.

For starting the motor generator set, a 60-cell, 125-volt storage battery is provided, which also energises the control circuits and compressor motor when the set is shut down.

Data are tabulated in Table III. *ante* and an outline diagram of the locomotive is given in Fig. 10.

Models and Analogies for Demonstrating Electrical Principles.

No. XVIII.*

We are indebted to Mr. E. B. Moullin, of the Engineering Laboratory, Cambridge, for the following notes on the equivalence between the torsional oscillations of several fly-wheels mounted on an elastic shaft and the currents in an electrical filter circuit. Let Fig. 144 represent a system of fly-wheels mounted on an elastic shaft which is free to turn in bearings and is acted on by an alternating couple of maximum value T. Let I_1, &c., represent the fly-wheels

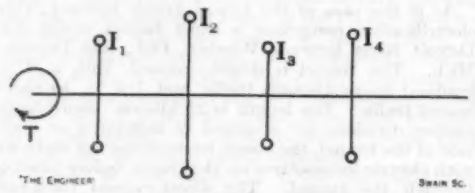


FIG. 144—FLY-WHEEL SYSTEM

having moments of inertia I_1, &c., mounted on a uniform shaft of negligible mass. Let λ_1, λ_2, &c., represent the stiffness of the shaft between I_1, I_2, &c.; λ is defined as the torque required to produce a radian of twist in that length of shaft. Let θ_1, θ_2, &c., be the angles at time t between a fixed reference plane through the shaft and fixed radii drawn on I_1, &c. The fixed radii are such that $\theta_1 = \theta_2 = \theta_3$, &c., when the whole system is at rest. Let the end of the shaft be acted

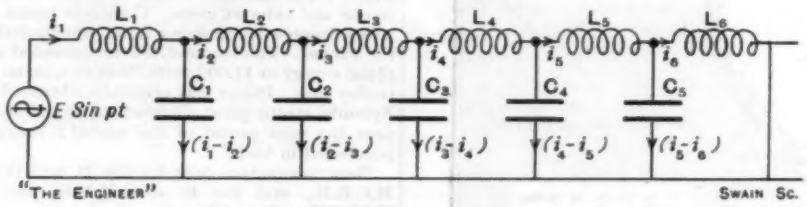


FIG. 145—ELECTRIC FILTER CIRCUIT

on by a harmonic couple T cos $p\,t$. Then the equations of motion are as follows :—

$$I_1\ddot{\theta}_1 + \lambda_1(\theta_1 - \theta_2) = T\cos p\,t \quad . \quad . \quad . \quad . \quad . \quad (1)$$

$$I_2\ddot{\theta}_2 + \lambda_1(\theta_2 - \theta_1) + \lambda_2(\theta_2 - \theta_3) = 0 \quad . \quad . \quad (2)$$

$$I_3\ddot{\theta}_3 + \lambda_2(\theta_3 - \theta_2) + \lambda_3(\theta_3 - \theta_4) = 0 \quad . \quad . \quad (3)$$

&c. &c., up to n equations for n masses.

Now consider the electrical circuit depicted in Fig. 145, where L_1, L_2, &c., are inductances and C_1, C_2, &c., capacities, and i_1, i_2, &c., are the currents in the various branches at time t and q_1, &c., the various corresponding charges on C_1, &c.

Then $L_1\dfrac{d\,i_1}{d\,t} + \dfrac{q_1}{C_1} = E\sin p\,t$,

$$\therefore L_1\frac{d^2\,i_1}{d\,t^2} + \frac{i_1 - i_2}{C} = p\,E\cos p\,t \quad . \quad . \quad (\alpha)$$

$$\frac{q_1}{C_1} = L_2\frac{d\,i_2}{d\,t} + \frac{q_2}{C},$$

$$\therefore L_2\frac{d^2\,i_2}{d\,t^2} + \frac{(i_2 - i_3)}{C_2} + \frac{(i_2 - i_1)}{C_1} = 0 \quad . \quad . \quad (\beta)$$

$$\text{Sim.}: L_3\frac{d^2\,i_3}{d\,t^2} + \frac{i_3 - i_4}{C_3} + \frac{i_3 - i_2}{C_2} = 0 \quad . \quad . \quad . \quad (\gamma)$$

&c. &c., up to n equations for n inductances.

Equations (α), (β), (γ), &c., are identical with (1), (2), (3), &c., if we replace I_1, &c., by L_1, &c., and λ_1, &c., by $1/C_1$, &c., and the torque T cos $p\,t$ by the voltage E sin $p\,t$, where T is equivalent to p E. The angle of twist in each part of the shaft is seen to be equivalent to the current in the corresponding condenser and the motion of each mass is equivalent to the current through each corresponding inductance.

Having recognised the equivalence between the dynamical system of Fig. 144 and the electrical circuit of Fig. 145, we may transpose readily from currents to motions or *vice versâ*. We may note in passing that there would be the same equivalence between the circuit of Fig. 145 and a suspended system of masses connected together by a series of light spiral springs. It is important to be able to calculate the resonance frequencies of a system such as that shown in Fig. 144, which, for example, may represent the cranks and fly-wheels of a multi-cylinder engine.

* No. XVII. appeared December 3rd.

Referring now to equations (1), (2) and (3), &c., we have a system of n linear differential equations to determine the n variables and suitable elimination will produce a differential equation containing only θ_q and its derivatives. From this the motion of the qth member of the group of n may be determined. If n exceeds, say, 4, it is necessary to devise a system of elimination in order to arrive at the equation in θ_q with reasonable ease.

But having recognised the equivalence of Fig. 145 we may dispense with the differential equations and elimination and use the vector algebra familiar to all alternating-current engineers. Then we shall arrive at the desired equation in θ_q by the simple process of adding algebraic fractions. But having recognised the electrical equivalent, certain resonance conditions are often apparent at once, which are generally less apparent in the dynamical system. Further, we have, if we so desire, a valuable experimental method of measuring the critical speeds and shaft stresses which would occur in a proposed crank shaft, because we may construct a model of the system where each mass is replaced by a suitable inductance and each shaft section by a suitable condenser.

Let us consider how to calculate the resonance frequencies of the circuit of Fig. 145, which is well known and is called a "low pass" filter. To find the resonance conditions we have only to write down an expression for the impedance of the circuit and equate this impedance to zero. The circuit may be represented more conveniently by Fig. 146, where R_1 is the impedance of L_1 at frequency p, so that $R_1 = r + j\,p\,L_1$, where r is the resistance of L_1 and $j = \sqrt{-1}$, Similarly, $S_1 = -j/p\,C_1$. Though R_1, S_1 are complex. we need not introduce imaginaries until the final equation, and may add R_1, S_1, &c., as though they were simple resistances. Considering first the impedance of the network beyond the points A B, Fig. 146, we have R_6 S_5 in parallel and in series with R_5.

Hence the equivalent impedance z is given by

$$z = R_5 + \frac{1}{\dfrac{1}{R_6} + \dfrac{1}{S_5}}.$$ From this it follows that the impedance Z of the whole network may be represented by the continued fraction

$$Z = R_1 + \cfrac{1}{\cfrac{1}{S_1^{-1} + \cfrac{1}{R_2 + \cfrac{1}{S_2^{-1} + \cdots \cfrac{1}{S_n^{-1} + \cfrac{1}{R_{n+1}}}}}}}$$

This may readily be evaluated for any reasonable number of terms and then by replacing R_1 by $j\,p\,L_1$, &c., and equating Z to zero we obtain an nth degree equation in p^2, the roots of which will give the n resonance frequencies of the circuit. A particular example of interest is when $R_1 = R_2 = R_3$, &c. $= a$ and $S_1 = S_2$, &c. $= 1/b$, and $r_1 = r_2$ &c. $= o$. Let $a\,b = -k$ or $p^2\,L\,C = +k$: If p_0 is the resonance frequency of L and C by itself then $k = p^2/p_0^2$.

Let $\dfrac{\alpha_1}{\beta_1}$, &c., be successive convergents to the continued fraction. Then

$$\frac{\alpha_2}{\beta_2} = \frac{a\,b + 1}{b} = \frac{-k + 1}{b}$$

$$\frac{\alpha_3}{\beta_3} = \frac{a(-k + 2)}{-k + 1} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad \text{2 cranks.}$$

$$\frac{\alpha_4}{\beta_4} = \frac{k^2 - 3k + 1}{b(-k + 2)}$$

$$\frac{\alpha_5}{\beta_5} = \frac{a(k^2 - 4k + 3)}{k^2 - 3k + 1} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad \text{3 cranks.}$$

$$\frac{\alpha_6}{\beta_6} = \frac{-k^3 + 5k^2 + 1}{b(k^2 - 4k + 3)}$$

$$\frac{\alpha_7}{\beta_7} = \frac{a(-k^3 + 6k^2 - 10k + 4)}{-k^3 + 5k^2 - 6k + 1} \quad . \quad . \quad . \quad \text{4 cranks.}$$

$$\frac{\alpha_{11}}{\beta_{11}} = \frac{a(-k^5 + 10k^4 - 36k^3 + 56k^2 - 35k + 6)}{-k^5 + 9k^4 - 28k^3 + 35k^2 - 15k + 1} \quad . \quad . \quad . \quad . \quad . \quad \text{6 cranks.}$$

To obtain the resonance frequencies for a six-crank system we equate α_{11} to zero and obtain $k^5 - 10k^4 + 36k^3 - 56k^2 + 35k - 6 = 0$.

Similarly, to obtain the conditions that the motion of I_1 should be zero we equate β_{11} to zero and obtain $k^5 - 9k^4 + 28k^3 - 35k^2 + 15k - 1 = 0$.

The resonance conditions are given by $k = 0{\cdot}27$, 1, 2, 3, and 3·73. It may readily be seen that $k = 1$ is one resonance condition for when $p = p_0$, S_3 R_4 form a parallel resonance circuit which has infinite impedance and so has absolutely no effect across S_4. Hence S_4 does not feel the presence of the latter part of the network. The elements R_4 S_4 form a series resonance circuit which has zero impedance and so is an absolute short circuit across S_3. R_3 is now in parallel with S_2 and together have infinite impedance. Hence S_1 is not affected by the latter part of the network and we are left with R_1 and S_1 in series which, together, have zero impedance, so that the whole circuit is in resonance and in the absence of resistance there is an infinite current everywhere.

Let us now consider the condition when $k = 2$.

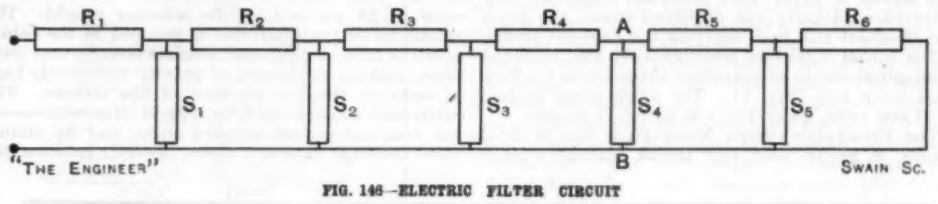


FIG. 146—ELECTRIC FILTER CIRCUIT

Each inductance now has impedance $\sqrt{2}\,p\,L$ and each condenser and impedance $1/\sqrt{2}\,p\,C$. If we denote the former by 2 X then the latter will be $-$ X. Now C_3 and L_4 in parallel evidently have impedance $-$ 2 X, and this in series with L_5 makes a short circuit across C_4. Similarly C_2 is short circuited and the remaining part of the system will have zero

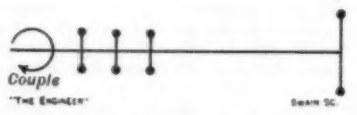


FIG. 147—VIBRATING SYSTEM NO. 1

impedance just like the portion of the circuit beyond C_4, and the current will be large everywhere except in C_3 and C_4, where it tends to zero.

We have been considering a system of equal masses, such as, for example, the cranks of a six-cylinder engine, but usually such a crank shaft will

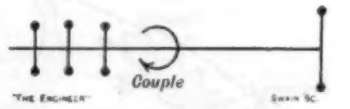


FIG. 148—VIBRATING SYSTEM NO. 2

be connected to a system of fly-wheels. The necessary additions to the equations are readily made, for it may be shown that in any vibrating system having one degree of freedom the resonance frequencies cannot be altered by altering the location of the forcing couple. Thus the resonance frequencies of system 1 in Fig. 147 are the same as those of system 2, Fig. 148.

In an electrical circuit this is expressed by saying

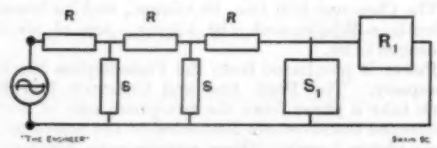


FIG. 149—CIRCUIT CORRESPONDING TO SYSTEM NO. 1

that the resonance frequencies are independent of the position of the E.M.F.; thus the resonance frequencies of circuit (1), Fig. 149, are the same as those of circuit (2), Fig. 150.

We have obtained an expression for the impedance of that part of the circuit to the left of line A B, Fig. 150, and the impedance of the part to the right is $\dfrac{R_1\,S_1}{R_1 + S_1}$.

For resonance the impedance of the two components

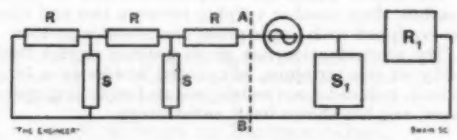


FIG. 150—CIRCUIT CORRESPONDING TO SYSTEM NO. 2

in series must be zero. Thus for six cranks and a fly-wheel we must have

$$\frac{\alpha_{11}}{\beta_{11}} + \frac{R_1\,S_1}{R_1 + S_1} = 0,$$

The modification for adding two or more fly-wheels will be obvious from the foregoing examples.

Let us now transfer what we have found out about the currents in Fig. 145 to the motions of the fly-wheels in its dynamical counterpart illustrated in Fig. 151, where we have six equal fly-wheels fixed at even distances along a light uniform shaft which is mounted freely in bearings.

When $k = 1$ in Fig. 145 we saw that the current in C_3 was zero and the current in L_3 equal to that in L_4 in magnitude and phase, whilst the currents in L_2 and L_5 are zero. Now the current in L_6 lags a quarter period behind the P.D. across C_5 and hence behind the P.D. across C_4; but the current through C_4 leads this P.D. by a quarter period and so the currents in L_4 and L_3 are in antiphase. Similarly, with the currents in L_1 and L_2. Translating this to Fig. 151, we see that I_2 and I_5 should be at rest, I_3 and I_4 moving together as one body and in antiphase with I_1 and I_6. Arrows are drawn on the figure to illustrate

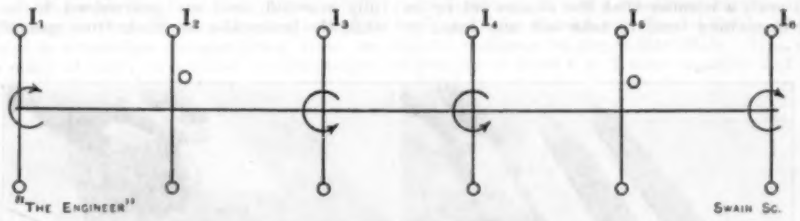


FIG. 151—FLY-WHEEL SYSTEM

this condition of motion. Evidently this motion gives zero angular momentum to the system and could be produced by twisting I_1 and I_6 through a clockwise angle θ and I_3 with I_4 through an anti-clockwise angle θ and then releasing the system. We then have the familiar two-node vibration with nodes at I_2 and I_5.

Now consider when $k = 2$ in Fig. 145. The currents in L_3 and L_5 are evidently equal and in antiphase, the current in C_4 is zero, &c. Hence now we find I_1 turning as before, I_2 and I_3 turning together anti-clockwise, I_4 and I_5 turning together clockwise, and I_6 anti-clockwise. Again, the motion is possible in a free system as there is zero angular momentum; it is a three-node vibration with nodes at the mid-points of the first, third, and fifth sections of the shaft.

Now consider when $k = 3$ in Fig. 145. The current in L_2 is twice the current in L_6 and in antiphase with it, whilst the current in C_3 is zero. Translating this to Fig. 151 we find I_1 clockwise with amplitude θ and I_2 anti-clockwise with amplitude 2θ, I_3 and I_4 moving as one body clockwise with amplitude θ, and so on symmetrically with the first half of the shaft. This is possible for the four-node vibration with nodes one-third the way along the first and last sections and two-thirds along the second and fourth. The one-node and five-node motions are less readily followed because of the non-integral values of k.

In electrical circuits currents are observed by a very common instrument, the ammeter, whereas it requires very complicated apparatus to observe mechanical vibrations. Hence the electrician is continually enlarging his experience by observation with everyday means and therefore possibly may obtain the experience to predict resonance more readily than the mechanical engineer, who has no simple resonance indicator and stress recorder always in use. For this reason it seems that recognition of the electrical equivalent may serve a useful purpose.

So far the function of replacing the dynamical system by its electrical equivalent has been to provide a ready means of elimination among a set of linear differential equations. It provides a simple method of arriving at an nth degree algebraic equation, but this it does not solve.

We may solve experimentally the nth degree equation in k by constructing the electrical model just described or we may solve the whole problem graphically by well-known funicular methods. (For example, see Gumbel, *Z.V.D.I.*, 1912, p. 1025.)

Transit Facilities in London.

THE London Traffic Act, 1924, has been the means of making public the inconvenience endured by the long-suffering residents in the North, North-East and East of London when making their morning and evening journeys to and from their work in the inner area of the Metropolis. Under that Act a London and Home Counties Traffic Advisory Committee was appointed, and that body, in October, 1925, held an inquiry into the travelling facilities in North and North-East London, and, in March last, another into the conditions in East London. In passing, it may be remarked that the public hearings in a third inquiry—on South-East London—has just been concluded. The report on the first inquiry, dated March, 1926, and that on the second, under date August 7th, 1926, were issued simultaneously last week, and whilst the comments we have to make are based on the former, they apply equally to the other report.

We were struck when reading the North and North-East London document with the remarkable fact that the numbers using certain means of conveyance are now less then they were. For instance, whilst the train service on the London and North-Eastern, judged by the train mileage, is greater than it was in 1913, yet the number of passengers is 20 per cent. less. The traffic to and from the London Electric Railways through Finsbury Park is 25 per cent. less than in 1919 and through Highgate 18 per cent. less. The cars of the Metropolitan Electric Tramways Company carry 16·8 per cent. fewer passengers than in 1922, and those of the London County Council 8·2 per cent. less. It may also be remarked that on the Finsbury Park line of the London Electric Railways there are provided 75,000 seats for the 18,000 passengers who use the line daily. At the peak hours there are 144 cars per hour on that section, and they could, if necessary, be increased to 280 cars. Whilst the railways have experienced this diminution, the users of omnibuses have greatly increased, and the example is given of the Southgate–Victoria service of the London General Omnibus Company, which has recorded an increase of 134 per cent. in three years. It is worth noting that it was in 1922, that is, three years ago, that the independent omnibuses began to run. The London General Omnibus Company and the Metropolitan Tramways Company, being members of the same "combine," had an understanding as to the provision of alternative facilities and the invasion of the independent companies forced the "London General" to put on more vehicles, and that in some measure accounts for the drop of 16·8 per cent. in the tramway company's passengers.

The congestion in the North and North-East area appears to have occurred at Finsbury Park, and to have been due to passengers in the morning changing from omnibuses and trams from the outer area into steam and electric trains for the City and elsewhere, and *vice versâ* in the evening. North of that point all rail communication is in the hands of the London and North-Eastern Railway, but the area south thereof is served also by two other companies—the Metropolitan with the Great Northern and City, and the London Electric Railways, with the Great Northern, Piccadilly and Brompton. The former line was constructed with the idea that it would make a physical connection with what was the Great Northern Railway, and is of the necessary increased dimensions to carry that company's rolling stock. But the Act of 1902, which authorised it, put a veto on the line going further north without the consent of the Great Northern. A similar veto was placed on the London Electric Railways Company extending its tube railway. A more reasonable attitude was taken up by the Great Northern in 1914 as to the Great Northern and City line, but it was not until 1924 that the restraint was removed. It is, however, clear that this situation would have been easier had the Great Northern allowed the junctions between the two railways to be made at Drayton Park, as was provided for when the Great Northern and City was sanctioned. For all this, it must be remembered, the London and North-Eastern is not to blame; it is a trouble it inherited from the Great Northern when that line was taken over under the Railways Act, 1921. The point on which the London and North-Eastern Railway is criticised is that it has not converted its lines for electrical operation. The company's reply seems to us a perfect answer. The cost, including the necessary flying junctions and similar works, would be £100,000 per mile; in fact, with power stations, new rolling stock and possible widening of some tunnels, the total expenditure would amount to "many millions of money." The directors therefore passed a resolution, quoted in the report, to the effect that in the present position of the railway industry they could not pledge themselves to adopt the proposal. The present report proceeds to observe that it is stated that the chief considerations which actuated the company in arriving at that decision were (1) that any new capital expenditure, no matter how small, which might be entered upon at the present time for the purpose of electrifying a part of their system, would inevitably lead to a very large capital outlay, since the policy of electrification, once commenced, would have to be progressive; and (2) that the conditions obtaining in London, in the matter of competition for suburban traffic, do not permit of a reasonable return on capital expenditure on local railway transport.

One further proposal remains to be mentioned, and it is of a more recent date and has been less advertised than the others. It is that the Piccadilly Railway should be extended northwards to join the London and North-Eastern at Wood Green. On that point the report observes that although the London Electric Railways have declared themselves as satisfied that there is sufficient traffic to warrant the extension of the Piccadilly Railway northwards to Wood Green, and have stated, moreover, that there would not appear to be any physical difficulty in the way of such extension, they, in common with the London and North-Eastern Railway, appear to have come definitely to the conclusion that so long as their undertakings remain subject to the existing competition of road transport, they will not be prepared to embark upon any scheme involving any considerable capital expenditure. The present Committee, over which Sir Henry Maybury has presided, recommends that the London Electric Railways Company should seriously consider the question of extending the Piccadilly Railway, and the report then proceeds to say that the Committee will obtain further information and report again as to the electrification of the London and North-Eastern Railway and of a junction between the Great Northern and City and that company at Drayton Park.

Naturally, the alleged evil of the existing competition of road transport is considered in the report, and thereon it is remarked that the proposals submitted by Mr. Frank Pick, on behalf of the Underground group of railways and the London General Omnibus Company, for the establishment of a common management and a common fund, appear to present a possible solution of the whole problem of London passenger transport, and it is recommended that these proposals be carefully examined with the least possible delay. We see many difficulties in the way of such a scheme—which would cover the whole of London and not alone the districts complained of. There are, first, the lines in the London area of the trunk railways, each of which carries a valuable suburban service. It is difficult to imagine the big companies consenting to any dictation therein. A second obstacle would be presented by the Metropolitan Railway Company, which has not only an important share of the electrically operated lines within the inner area of the Metropolis, but a very dense traffic to and from the outer area. It is opposed to any such scheme. Lastly, there is the London County Council. Is it likely that it would come into such a fold, even to save its decadent tramways? The report says that some local authorities and other public bodies appear to be apprehensive that their difficulties are being exploited by the railways for the purpose of obtaining a cessation of omnibus competition. A resolution, advocating unified operation of local passenger transport undertakings in Greater London, passed by the London County Council on May 3rd, 1921, is quoted in the present report as significant, but we would point out that the resolution in question favoured a municipal traffic control authority, to be appointed by the local authorities affected. There are objections, too, to any such common management and common fund, the chief of which is that it means the creation of a vast trust in transportation, a monopoly in the popular means of communication and the destruction of that competition which is essential to progress.

The Manufacture of Files at Templeborough Works, Sheffield.

By J. W. WALKER (Works Manager).

No. III.*

HARDENING: HEATING METHODS, LEAD BATHS, COKE HEARTHS, QUENCHING MEDIUM, PROTECTION OF TEETH.

To harden files correctly the essential points to be observed are to:—

(1) Protect the teeth from damage during heating.
(2) Heat to the correct temperature.
(3) Take preliminary precautions to insure that the file shall emerge from the quenching medium as straight as possible.
(4) Quench in the correct medium with the temperature of the file falling, taking care of the angle of immersion and subsequent motion of the file in the quenching bath, to maintain straightness or to produce straightness from an initially curved file, which involves skill and experience on the part of the hardener for some types.
(5) Finally straighten by means of local quenching.

Taking these points in the above order:—

(1) The teeth are protected by various mixtures. At the Templeborough Works a thick paste of flour and charcoal is applied to the file by means of a brush. The paste fills the hollows between the teeth and gentle heating sets it hard, thus preventing the lead, which is usually employed as the heating medium, from adhering to the teeth, the removal of which would present difficulties apart from the question of expense due to the waste of lead.

(2) The correct temperature to which files made from steel containing 1·2 per cent. to 1·4 per cent. carbon should be heated lies between 750 deg. and 770 deg. Cent. The quenching should take place when the temperature is just falling. The methods employed to obtain and judge the correct temperature

* No. II. appeared December 3rd.

vary widely from the crude breeze hearth, where the heater must judge the temperature by eye, to the most elaborate salt-bath or lead-bath furnace fitted with recording pyrometers and means for automatically controlling temperature.

At the Templeborough Works lead-bath furnaces are used exclusively for this particular process. Lead, because of its higher specific gravity, causes the files to float against a stop placed across the top of the bath. In this way all similar files may be heated to the same distance from the shoulder, and the operator is enabled to work on several files simultaneously. Lead will maintain a uniform temperature throughout its mass, and transfer the heat in a gentle and uniform manner to the files. The loss of lead due to oxidisation is not great at the comparatively low temperature required for hardening, and further, the most delicate shapes and sections are not damaged, as is the case when breeze hearths are used. (See Fig. 27, page 638.) Pyrometers are used to check the temperature of the bath, and gas and air regulators are fitted to each furnace so that the temperature can be controlled at will.

FIG. 23—SAND SCOURING MACHINE

Lead-bath furnaces are also heated by means of oil, coal and coke, but whatever heating medium be employed, it is essential that the temperature be subject to effective control, and with gas control is much easier than with either coal or coke. In the case of the two latter fuels, regular firing and dampers are necessary to regulate the temperature.

(3) Considerable experience is required to insure that a batch of files shall be brought out from the quenching bath, all uniformly straight. For example, half-round files are bent whilst hot for hardening, immediately before quenching. The amount of the bend and the particular shape of the bend depend on the size of the file, its contour, and its cross-section. Experience indicates the correct amount of bending required, in order that the unequal rate of cooling of these particular sections, which cause unequal strains and distortion during hardening, may operate on the initially distorted files and cause them to come out of the quenching bath comparatively straight. It will be realised, when consideration is given to the infinite variety of shapes and sizes, that no hard and fast rules can be laid down to insure straightness, and that the success of the process depends to no small extent on the skill and experience of the hardener.

FIG. 24—"PROVING" FILES

(4) The correct medium for quenching is brine, *i.e.*, water to which salt is added in certain proportions. By quenching in brine, the risk of cracks developing during the cooling is greatly diminished, the rate of cooling being slower as compared with water quenching. Further, it is important to keep the temperature of the quenching bath as near constant as possible, which may be done in various ways, *e.g.*, by circulating the brine; but more efficiently and conveniently by using tanks of large capacity which will enable considerable quantities of files to be hardened without material increase in temperature of the bath.

(5) When all possible precautions have been taken to bring the files out straight—*i.e.*, initial bending, care regarding angle of immersion, and motion of file in the cooling bath—it is always found that some files are more or less crooked. This crookedness is removed by springing the file on a straightening block, whilst the file is still fairly warm from the cooling bath, straightness being further insured by finally quenching the file locally, the quenching being performed in such a manner that the strains set up in this local quenching tend to take out any bend or crookedness which may exist at this stage. (See Fig. 28, page 638.)

Scouring.

After hardening, the file presents a dirty, black appearance as a result of the previous heating, the teeth being filled with the burnt remains of the protective paste used during the hardening operation. This dirt is removed by means of a jet of sand and steam, the jet being forced through a specially constructed nozzle and thereby caused to impinge on the teeth of the file at the correct angle. (See Fig. 23.) The scouring action of this stream of sand and steam removes all the dirt and stains and leaves the file with a clean appearance.

Sand Blasting.

Sand blasting is carried out in a similar manner to the scouring operation just described, but the sand stream is caused to impinge on the back side of the teeth. The object of sand blasting is to remove the ragged edges which are left on the tips of the teeth after cutting. It is argued that if the ragged edges are left on, and the file is put to work without sand blasting, these edges are not sufficiently supported by the main body of the tooth and are quickly broken away, taking more material during such breakage than would be the case if they were removed by sand blasting, and thereby spoiling the file. This contention does not appear to be substantiated by actual test, as comparative mechanical tests on similar files show no appreciable difference whether the sand-blasting operation has or has not been carried out.

Tang Annealing.

After scouring and sand blasting the files are immersed in lime water to prevent rusting, and afterwards dried off, usually on steam-heated racks. The tangs are then heated in a lead bath to approximately 750 deg. Cent., and are allowed to cool slowly in the air, which has the effect of taking out the forging and hardening strains. This process is called "annealing," but it is, in fact, "normalising."

Proving and Inspecting.

After tang annealing, the files are sent to the warehouse, where they are inspected, tested and passed for packing. (See Fig. 24.) "Proving" is the name given to the operation of testing the files for hardness. A piece of steel of known hardness is drawn across the file under test, and if the teeth are soft the prover slips across the teeth without being cut, but if the teeth are hard the tester can feel the resistance offered by the cutting action, and is thus enabled to pass or reject the file. After proving the hardness, the files are tested for soundness by striking a smart blow on a steel block; the dead sound which accompanies this action when performed with a cracked file enabling the inspector to detect and reject any file which does not ring true. The files are also closely scrutinised for bad cutting, faulty shapes, bad marking, &c., at all stages of manufacture, and also after the final proving and testing, so that all precautions are taken to prevent any faulty files being dispatched.

Packing.

After proving and testing, the files are ready for packing. Great care and attention is paid to this important matter. The wrapping papers are carefully selected, and are guaranteed to be acid-free, while the boxes also are made from specially selected material. Large stocks of these materials are kept in special racks in a large well-ventilated bond room, the boxes and paper being kept for a minimum period of three months to ensure that they are thoroughly dry before being used.

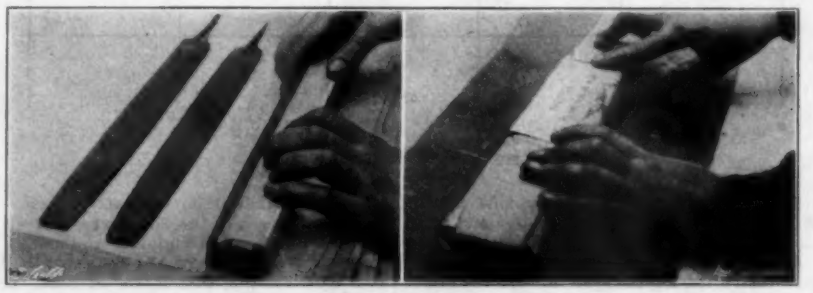


FIG. 25—WRAPPING FILES

The files are first wrapped in waxed paper in lots of one dozen or half-dozen, depending on the type and size. Every care is taken to prevent contact between the teeth of adjacent files. (See Fig. 25.) If the files were allowed to touch each other, the teeth would rub against each other and be broken in transit. The bundle of six or twelve files is then securely bound by means of strong string and placed in a cardboard box of the correct size. Labels setting out the full details of the contents of the box are affixed to the end of each box, thus enabling the storekeeper or salesman to see at a glance the types of file at his disposal. (See Fig. 26, and Figs. 29 and 30, page 638).

Independent Testing.

After large orders are complete and before the customer takes delivery, it is usual for his representative or inspector to select at random from the boxed goods certain proportions of the files for independent testing. The proportion selected for this test varies with different clients, but is usually in the region of 1 in 500.

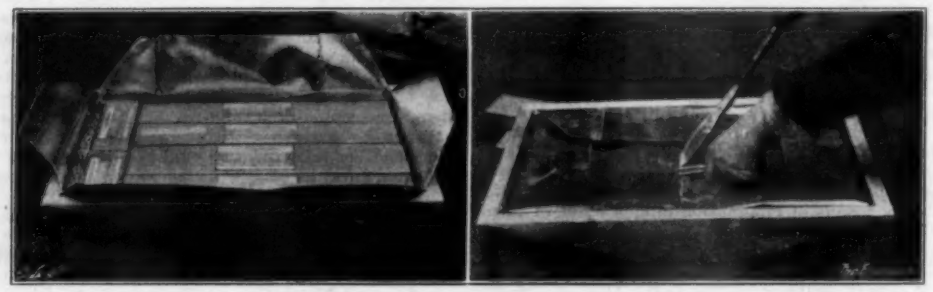


FIG. 26—SOLDERING THE INNER CASES FOR SHIPMENT

The tests are generally carried out by a public testing company or authority. In order to get comparable results, it is necessary to take the following precautions:—

(1) Test bars of uniform hardness and composition must be procured.

(2) Testing machines capable of applying a definite pressure between the file and test bar must be used.

(3) Arrangements for automatically recording the number of strokes and the amount of material removed during the test should be made.

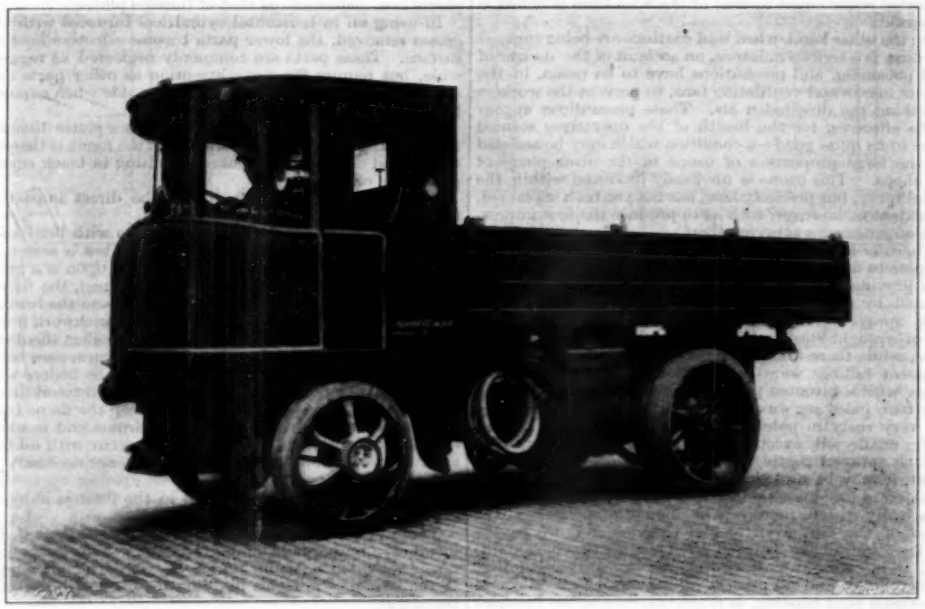
Two kinds of test bars are in general use for file testing:—(*a*) A steel bar of 1in. square section, having carbon 1 per cent., silicon ·1 per cent., manganese ·3 per cent. This bar is used in the annealed condition and gives a Brinell of 180. (*b*) A steel bar of 1in. square section, having carbon ·6 per cent., silicon ·3 per cent. and manganese ·8 per cent. This bar is used in the normalised condition, and gives a Brinell of 228.

The most common form of machine employed for testing is the Herbert machine. This machine carries the file in a reciprocating holder similar to a

power hacksaw. The length of stroke for testing files of 12in. and upwards is 6in. The number of strokes per minute is usually fifty. The test bar is pressed against the file under test, the pressure being uniform, and is usually 30 lb. per square inch of test bar area. A record is automatically taken of the amount of test bar filed away, and the number of strokes taken during the operation. A graph is obtained, and from it the rate of cutting and other valuable information is obtained from which the performance of various files may be compared and tested against the specification of the inspector or consulting engineer.

The Smithfield Club Show.

THE annual Show of the Smithfield Club, which opened at the Agricultural Hall on Monday last, and closes to-day, is somewhat disappointing from an engineering point of view, on account of what might



6-7 TON STEAM WAGON—FOWLER

be described as the "lackadaisical" attitude of many of the exhibitors. Thus, we have often bemoaned the fact that such and such a Show was precisely similar to its precursor, and again the same must be said of a large proportion of the exhibits this year. There are, however, a few elements of novelty, and perhaps one of the most striking was that found just inside the main entrance arcade. Burrell's stand is not occupied by the familiar showman's traction engine, resplendent with polished brass stanchions and gorgeous paintwork, but displays instead a plain straightforward traction engine, just as an engineer—not a showman—would like to see it.

There is, again, another characteristic about this Show. It indicates the fact that our manufacturing engineers have discovered that there are two distinct "fields" in the way of road transport by steam—there never seems to have been any great sympathy with petrol lorries at the Show. These two fields are peculiar to the "overtype" and the "undertype" wagon. The overtype is, of course, almost the precursor, for one must not forget the early efforts that came from Homefields, Chiswick.

Anyhow, at one time, not so far distant, the overtype—that is to say, a miniature traction engine with a body on the same wheels—was undoubtedly the most popular steam wagon; but then came the modern undertype, with the engine tucked away inside the framing, and it was, and still is to our mind, the more comely form. When it comes to service, however, appearance is not always of first consideration, and conversation with the exhibitors at the Show leads one to the conclusion that a firm which relies on public advertisement to any extent for the prosperity of its business will lean towards the undertype wagon, with its smooth exterior; while the contractor who only cares for dragging stuff through any conditions will vote for an overtype machine.

In these circumstances it is noteworthy that those firms which have been generally accepted as exponents of either one or the other of these theories are gradually adopting a dual capacity, and are making both types of vehicle. Fodens, for instance, are essentially associated with the idea of an overtype wagon, and that is the form they are showing at the Agricultural Hall, but we hear that an undertype has been produced, and tested for some time on the road with considerable success. On the other hand, a Clayton and Shuttleworth generally means to the road contractor an undertype; but the principal exhibit on the stand of this firm is an overtype steam wagon.

What it appears to come down to is that a small concern doing general haulage work should rely on the overtype wagon, which is simple and easy to overhaul, while a large company, with ample resources in the way of engineering shops, may find it worth while to overlook the extra expence in order to get the appearance of the undertype. Again, most—not all—undertypes have simple-expansion engines, while the overtypes have compound cylinders, which gives the latter an advantage in water consumption in general running and the ability to surmount short, steep gradients by admitting high-pressure steam to the low-pressure cylinder, without it being necessary to change gear.

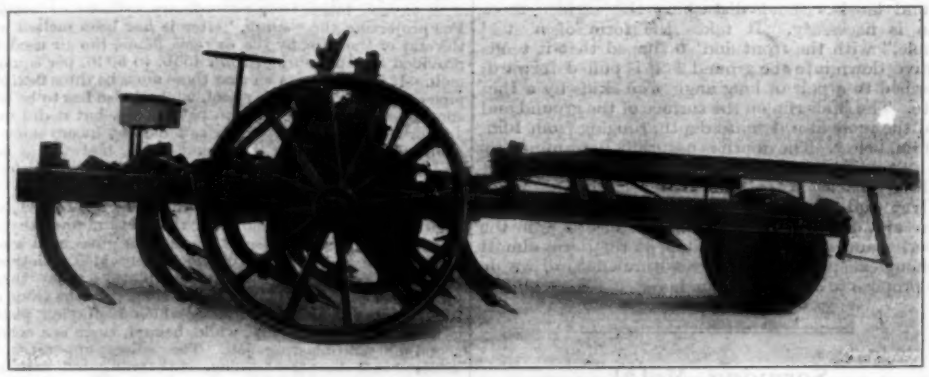
However, it may be as well to break away from this controversial matter, and mention one of the wagons which has not a counterpart in the products of its manufacturer. It is the machine which we illustrate, made by John Fowler and Co., of Leeds, shown just by the entrance to the Gilbey Hall. This wagon is nominally of from 6 to 7 tons capacity and its body can be tipped on either side or behind by means of a hydraulic ram operated by the main engine. The engine rather savours of Mr. Clarkson's ideas, in that it is of the Vee type with a transmission system through a three-speed gear-box and a propeller shaft to a worm driven back axle. The boiler is of the vertical fire-tube type, and is so constructed that it is very easy to clean or scale. On the same stand there is a very fine example of a "discer" for preparing soils for planting out in the spring, and although we imagine that many of our readers are not directly interested in agricultural affairs, this implement is decidedly interesting through demonstrating how the disposition of material can be arranged to meet heavy stresses and yet avoid undue weight.

The new overtype steam wagon which is shown by Clayton and Shuttleworth, of Lincoln, to which reference has just been made, is noteworthy, on account of its special arrangements for braking. It will, of course, be remembered that the regulations call for two separate brakes on such vehicles, and it has been suggested that if two brakes both act on one drum they may both fail through the drum breaking. Such a contingency is, however, guarded against in the Clayton wagon by having one of the brakes acting on a normal drum on the driving wheels, while the other engages with the inside of the rim of the wheel itself. It is consequently hardly conceivable, short of the complete wreckage of the machine, that the braking effect can become inoperative.

On the stand of Richard Garrett, Leiston, one usually expects attention to be attracted by a steam wagon or a thrashing machine, and although these familiar features are still there, the most striking exhibit is a sausage machine. It seems rather incredible, at first, that a firm like that of Garretts should take up the manufacture of such an article, but, as a matter of fact, our examination of it at the Show proved that its production is essentially an engineering proposition, while the design of the gear necessary so to interlock the several mechanisms that neither they nor the operator can come to any harm has involved very considerable ingenuity.

J. and H. McLaren, of Leeds, are showing the motor windlass for working ploughing or cultivating implements which we have described in connection with previous Shows, and while discussing its merits we elicited the information that although the engine is rated at from 60 to 70 horse-power when running on petrol—the larger power is developed at a speed of 1000 revolutions per minute—it will give as much as 62 horse-power when burning alcohol. For the latter fuel, however, the compression ratio must be increased. With paraffin the output of the engine is 48 horse-power. The cultivator on this stand, which we also illustrate, has been cursorily described before in THE ENGINEER, but several improvements have been embodied in the example shown this year. The machine is of the "turning" type—that is to say, it is turned round, end for end, at each headland of the field to work back across the next swarth. In turning two things must be done: the cultivating tines must be lifted out of the soil and the whole machine must be brought round in as small a circle as is possible in order to bring the next line of cultivation alongside the preceding one without leaving a big uncultivated headland. The first desideratum is met by mounting the whole machine on a cranked axle and connecting the draw-bar with the axle in such a manner that when the draw-bar is pulled athwartships, in the turning movement, the cranked axle is revolved on itself, and the whole machine is lifted to the extent of the throw of the cranks. The sharp turning is assured by scotching the wheel on the inside of the turn in the following manner:—On the inside of the rim of each wheel there is a series of notches, about ¼in. deep, with which a fork attached to the main frame may be made to engage. The two forks are separately controlled from the driver's seat, and are so formed that as the machine rises, in turning, they maintain proper engagement with the notches in the wheel. It will be readily understood that, by dropping the proper scotch into engagement, the inside wheel can be held, so that the implement turns round that wheel, as a pivot, and is ready to go back alongside its last track. The casting, which can be seen standing up rather prominently in our engraving, somewhat like a stag's antlers, is used when such an obstruction as a bridle path has to be passed in the middle of a field. On either of the carrying wheels there is fixed a sprocket with which this casting can be engaged, and then, as the wheel rotates, the whole framing is pushed bodily upwards and the tines are lifted clear of the ground. The castings on either side of the implement are so arranged that they share the weight equally, regardless of the incidence of the meshing of their teeth with those of the sprockets.

On the stand of Tangyes, Ltd., of Birmingham,



TURNING-TYPE CULTIVATOR—McLAREN

there are several oil engines ranging from 12 up to 32 brake horse-power, of both the cold-starting and the lamp-starting types, together with ram pumps, and a 4in. Tan-Gyro centrifugal pump. The general construction of the oil engines has already been described, but we noticed one minor detail that is novel, although perhaps not of great importance. The lubricator is driven by an excentric on the side shaft; but instead of using an ordinary strap round the sheave, there is a simple piece of round steel bent into the form of a shepherd's crook, which engages with a half-round groove in the excentric. It is claimed that the open appearance of the arrangement is more likely to remind the attendant that it

requires occasional lubrication than would the closed-in excentric strap. These engines, by the way, are governed at the inlet valve of the fuel pump, which is held more or less off its seat, according to the load, so that such oil as is not required is pumped back again. In view of the fact that the pump has to deliver against a pressure of about 1000 lb. per square inch, the suction valve is lifted by a very fine-threaded screw, so that a comparatively small governor can control it to a nicety.

Ruston and Hornsby, Ltd., Lincoln, have a thrashing machine, a large selection of oil engines, and some pumping plants. Among the oil engines there is a horizontal airless-injection set of 25 brake horse-power for running on crude, residual or tar oils, of which the fuel consumption is guaranteed to be not more than 0·48 lb. per brake horse-power per hour. There is also a 45 horse-power vertical cold-starting engine, for which a fuel consumption of from 0·4 lb. to 0·44 lb. is claimed. These vertical engines are fitted with a fuel distribution gear, which has been designed to eliminate the danger of one cylinder carrying less than its share of the load due to an unequal distribution of fuel to the cylinders. The distributor receives its oil by a fuel pipe, and consists of a reciprocating plunger having the requisite number of inlet and outlet ports, the latter directing the oil to the various atomisers in the correct sequence. No adjustments are needed to the distributor, and all adjustments to the pump, if necessary, can be made by one set screw.

Among the other exhibitors of oil engines there are Marshall and Sons, of Gainsborough, with a 12 horse-power fixed horizontal, a 16 horse-power portable horizontal, and a 50 horse-power single-cylinder vertical set; Blackstone and Co., of Stamford, have two engines of 55 and 9 horse-power respectively, of the spring injection type, an 11 horse-power vaporiser type set and some small petrol engines; while Petters, of Yeovil, are exhibiting their usual selections of small oil and petrol engines; but as all these machines have already been described in THE ENGINEER it is unnecessary to enlarge upon them here.

A new development for Crossley Brothers is a little oil engine, which is being made in three sizes, of 2, 3 and 6 horse-power, at the Elstow Works, Bedford. It is of the horizontal, hopper-cooled, four-stroke type, and is noteworthy on account of its moderate price. The crank case is totally enclosed, and instead of relying on the splashing effect of the big end for lubrication, a disc is fixed on the crank shaft and lifts the oil out of the sump into a distributing trough, from which it gravitates to the several bearings. Both the inlet and the exhaust valves are mechanically operated by a push-rod and cam on the crank shaft. Provisions are made so that the engine can be readily converted for cooling on the circulating system. It is a moderate-speed engine, running at 550 revolutions per minute in the case of the 6 horse-power size and 700 revolutions per minute for the 2 horse-power set.

Apart from those exhibits to which we have already made reference and the traction engines or wagons shown, for instance, by William Allchin, of Northampton; Aveling and Porter, of Rochester; Wm. Foster and Co., of Lincoln; and Wallis and Steevens, of Basingstoke, there is little more of direct engineering interest in the main hall, although the implements shown are, of course, the products of engineering firms. They have, however, mostly become of such a standardised form as to need no further reference. Nevertheless, Ransomes, Sims and Jefferies, of Ipswich, are showing a new implement in the form of a "mole-drainer"—that is to say, a device for opening up continuous drain holes a foot or so below ground level without disturbing the surface more than is necessary. It takes the form of a steel "mole," with the front end so shaped that it tends to dive down into the ground as it is pulled forward, attached to a pair of long angle iron skids by a thin plate. The skids run on the surface of the ground and hold the mole at a definite depth, ranging from 10in. to 18in. below. The depth is naturally determined by the power of the tractor used to draw the implement and the tenacity of the soil.

Over and above the exhibits in the main hall, there are, of course, a great number of others in the galleries and auxiliary halls, but as they are, almost without exception, of an agricultural nature, we do not propose to deal with them here.

Spraying Metal.

As a means of superimposing a layer of one metal upon a face of another metal, or, for the matter of that, on almost any other material, the process of spraying devised by Dr. Schoop is already familiar, but the general adaptability of the process is not, perhaps, well recognised, and, in the circumstances, the following notes based on the impressions gained during a visit to the works of Metallisation, Ltd., of Dudley, Staffs., may be of topical interest.

The actual process of spraying, by means of a "pistol," into which there are fed a wire of the metal to be sprayed, the oxygen and gas necessary for its fusion and a blast of air for the atomisation and projection of the wire, needs little explanation here, but the extent to which it is being adopted is not so fully understood. Again, presumably on account of analogy with the old-fashioned process of galvanising, it seems to be generally considered that the spraying system is principally confined to the application of zinc or tin coatings; but we noticed, during our tour of the works, examples of a variety of other metals and alloys being deposited. In this connection we made especial inquiry as to the composition of the resultant coating, and were assured that in the case of an alloy, such as brass or phosphor bronze, for instance, the analysis of the deposited coating was the same as that of the wire fed into the pistol.

This fact is of special interest, as it is an indication that there can be no oxidation or volatilisation of the metal in the spray, as either of those processes would tend to reduce the proportion of one ingredient, or the other, of the alloy. It appears, in fact, that the action of spraying is purely mechanical and is of the nature of hammering or projecting minute particles of the metal on to the surface to be treated in such a manner that they become felted together. The fact that there is no interaction between the spray and the base is borne out not only by microscopic examination and the behaviour of alloy coatings, as just mentioned, but also by another peculiarity of the process.

The amount of adherent metal deposited by the spray never equals the amount of wire consumed in the pistol, and the balance goes away as metallic dust. The difference may amount to some 25 per cent. of the original wire, according to the metal being used; but if it is collected it is found to be of the same composition as the wire. As a matter of fact, some pains are taken, at the Dudley works, to collect the dust when zinc is being sprayed, as it has a market value equal to that of the wire from which it is dispersed.

On the other hand, when lead coatings are being sprayed the dust is a serious nuisance, on account of the danger of lead poisoning, and precautions have to be taken, in the way of masks and ventilating fans, to prevent the workers breathing the dust-laden air. These precautions appear to be effective, for the health of the operatives seemed to us to be quite good—a condition which may be assisted by the large proportion of ozone in the atmosphere of the shops. This ozone is obviously produced within the metal spray, but precisely how, has not yet been explained. Its extent is, however, such as to produce the first impression on entering a spraying shop.

There is only one other generalisation with which we propose to deal, and that is the effectiveness of the protection provided by spraying. This matter was well demonstrated by the work's gates of Metallisation, Ltd., which were sprayed with aluminium some years ago. They are of wrought steel and are on the lee side of a blast-furnace, while there are factories on all sides. Some of the adjacent railings were coated at the same time as the gates with a bitumen paint and the remainder left bare. The bare pales are wasted away badly, the painted pales are very rusty in patches, but the sprayed gates appear to be unaffected, except where passing lorries have torn off the sprayed coating. In confirmation of this statement, it may be said that one of the gate rails had been sawn off to provide a sample, and while the bare sawn end was badly rusted, there was no indication of rust on the sides of the bar, even at the extreme end, where the hacksaw must have "ragged" the coating to some extent.

It is, of course, necessary to clean any surface before it is metallised, and no process of cleaning has been found to surpass sand-blasting, as it not only cleans but provides the roughness necessary for the adherence of the coating, and, for this reason, it is generally found more satisfactory to send any object which is to be sprayed to a properly equipped works, rather than do it *in situ*, although large pieces, such as bridges and structural work, are metallised outdoors. We found, nevertheless, that some big boiling pans had been brought to the Dudley works to be coated with copper, and they were so big—about 10ft. in diameter—that three men could conveniently work inside them at one time. On such work as this the men can cover approximately 1¼ square foot of surface per hour, but the rate of progress naturally depends upon the thickness of the coating, as, if a thick coat is required, it is necessary to go over the same area several times. In other words, the feed of metal into the spray cannot be increased beyond a certain well-defined limit, and, generally speaking, each individual layer is about one thousandth of an inch thick.

In the works coal gas is used in preference to acetylene for supplying the torches, and is compressed to a pressure of 25 lb. per square inch. It is burned in conjunction with oxygen taken from an ordinary cylinder or bottle. For projecting the "spray," after it has been melted off the end of the wire by the oxy-gas flame, the air used is provided at a pressure of from 45 lb. to 50 lb. per square inch. It will thus be seen that there must be three flexible pipe connections for each pistol, while it also has to be fed continuously with the wire to be sprayed, but it did not appear to us that the operator suffered any inconvenience from these connections. In some cases, however, a lad was stationed to see that there was no check in the feed of the wire.

For doing repetition work several special machines have been devised, and among them the most noteworthy is one for spraying the outsides of cast iron pipes with lead. It has two headstocks, each of which is provided with three chucks set equidistant round a face plate, so that three pipes can be accommodated at one time. In the front of the machine there is a bed along which a spraying pistol is travelled automatically, while, behind, there is a corresponding sand-blasting jet. The whole apparatus is enclosed in a sheet steel casing, and is connected with an exhausting fan. The procedure is as follows:—A pipe is put in place between the two headstocks and is turned round to the sand-blasting position. When it is completely cleaned the headstocks are moved through a third of a revolution and another pipe is inserted. In this position the first pipe is preheated by a series of gas jets, and it is then turned through another third of a revolution into the spraying position. All these operations are carried out automatically, and it is only for the purpose of taking out the finished pipe and recharging the machine that the attendant need go inside the casing, so that he is practically immune from risk of poisoning or dust.

Another, and a comparatively novel application of the spraying process, is in the building up of worn or damaged parts of machinery. We did not see any work of this kind in progress, but were able to inspect a steel gear wheel for a motor car, a broken tooth of which had been repaired by being built up with steel and filed to shape. The repair appeared to be quite effective, and was hardly distinguishable from the original metal, but we had no means of judging its actual strength. The built-up metal is admittedly somewhat softer than the wire from which it is made, but it is a peculiarity of sprayed metal that it is harder on the side than on the top, so that, for the purposes of a gear tooth, it is placed in the most advantageous position.

Oil Fuel for Steam Boilers.

THE following memorandum is being circulated by the Manchester Steam Users' Association to its members. We publish it because it is of interest to all who use liquid fuel for boiler firing.

A full supply of air to the burners must be maintained, otherwise partially burnt fuel passes into the flues, where it may re-ignite and cause serious damage. In one case which recently came under our notice the "secondary" flame did damage in a boiler side flue, and in another instance it occurred in an economiser flue.

Owing to the long flames, and also to the possibility of this re-ignition of the waste gases after partial burning, the shell plates may be exposed to high gas temperature and, therefore, when burning oil, the scaling of shell plates is as important as that of furnace plates.

In using oil in horizontal cylindrical furnaces with the grates removed, the lower parts become effective heating surface. These parts are commonly neglected as regards scale, but require the same attention as other parts and should be kept quite clean at the water side when exposed to heat.

The oil flame should not strike the furnace plates directly, as, apart from any risk of overheating, the flame is thereby cooled and combustion checked, resulting in black smoke and waste of fuel.

Seams should be protected from the direct impact of flame.

It is not necessary to line the furnaces with brickwork if the plates are clean at the water side, but a screen or bridge of brickwork for the flames to play upon is a great aid to combustion. If the furnaces are lined, the flames do not part with their heat at these parts, and the furnace tubes or combustion chamber beyond the brickwork lining have to take up excess heat. In vertical boilers the flame should be inclined downwards on to brickwork, care being taken to protect the base seam. Water-tube boilers with large combustion spaces lend themselves well to oil firing, but here also care should be taken to keep the flame from striking directly on the water tubes, drums and headers.

Flue gas explosions are more apt to occur with oil fuel than with coal or coke, and precautions are necessary in order to avoid them.

Unburnt or partially burnt oil in the flues is liable to explode.

Volumes of unburnt gas may pass into the flues if, for instance, a burner fails temporarily and is not at once shut off or relighted. Again, undue restriction of air supply to the burners will result in filling the flues with partially burnt gas.

Both these conditions are dangerous, and we recommend that the following precautions be observed in order to avoid gas explosions:—

The flames at the burners should be under constant observation. Should a flame be accidentally extinguished it should at once be relighted, or the oil shut off. If the burner has been discharging unburnt oil for an appreciable time the oil must at once be shut off and time allowed for the flues to clear before relighting.

The dampers should never be closed when burning oil. Steam output should be regulated only by the oil, steam, and air supply at the burners.

Under proper conditions there should be a light grey smoke from the chimney; dense black smoke indicates incomplete combustion, and white smoke shows that excessive air is being used.

Using oil and coal or coke together is not altogether desirable, although very convenient when the available coal supply is inadequate. In ordinary furnaces, such as in the Lancashire boiler, the combustion space above the grate is too small for the satisfactory combustion of oil fuel, and it is more satisfactory to burn coal only in one furnace and oil only in the other.

Oil leakages are, of course, very objectionable, and may be dangerous, especially if the oil finds its way into boiler flues. It will vaporise there and very likely explode.

Fuel oil in the open is not particularly dangerous, as it has to be finely divided before it will burn readily. But vapour from heated oil is another matter, and members will be well advised to adhere to their fire insurance companies' instructions as to necessary precautions.

BRASS SHEET AND STRIP.

THE British Engineering Standards Association has now issued four specifications covering various classes of brass sheet and strip material as follows:—Hot rolled yellow metal plates, sheet and strip (excluding condenser plates and ships' sheathing); brass sheet and strip for general engineering purposes; best brass sheet and strip; and cartridge brass sheet and strip.

The specification for yellow metal (No. 264) specifies a minimum copper content of 59 per cent., those for ordinary brass sheet and strip, and for best brass sheet and strip (Nos. 265 and 266) a minimum copper content of 61 per cent. and 65 per cent. respectively, and that for cartridge brass sheet and strip (No. 267) a range of from 68 to 74 per cent. copper. The specifications Nos. 265 and 266 also contain tables of tolerances on length, width and thickness.

An appendix is attached to each specification with the exception of that for yellow metal, giving particulars of Brinell, Shore Scleroscope, and Erichsen tests, which may be substituted, by mutual agreement, between supplier and purchaser, for the tensile test, or be used upon material the thickness of which renders the tensile test inapplicable.

Copies of these specifications can be obtained from the B.E.S.A. Publications Department, 28, Victoria-street, London, S.W. 1, price 1s. 2d. each post free.

Reinforced Concrete Silos at the Ougrée-Marihaye Steel Works.

No. I.

THE great Ougrée-Marihaye Steel Works near Liége have a history extending backwards for nearly a hundred years. Commencing as a privately-owned ironworks, the establishment was taken over by a limited company in 1836, with the principal object of manufacturing castings and machinery, though its future enterprise was foreshadowed by the company becoming interested in the exploitation of coal and iron mines and in the smelting and rolling of copper and zinc. In those days the works gave employment to about 300 men, and for the next twenty years or so the struggle for survival was difficult. In 1858, however, the manufacture of tires by the Gaudot process was commenced, and that development secured for the company the monopoly of the supply of tires in Belgium. Prosperity then began to dawn on the "Société Anonyme de la Fabrique de Fer d'Ougrée," as the undertaking was called. The works were extended and modernised, and in 1880, with a realisation of the trend of events, the management put down a Bessemer steel plant, which was soon followed by furnaces for steelmaking by the Thomas and Siemens-Martin processes. Ten years later the company was in a position to manufacture steel rails and boiler-plates with technical and economic success. There was then at Ougrée another old established company, namely, the "Société Anonyme des Charbonnages et Hauts Fourneaux d'Ougrée," founded in 1835. This company, as its name implies, owned and operated coal mines and blast-furnaces. Community of interests suggested a combination of forces, and in 1892 the two companies were amalgamated under the title of the "Société Anonyme d'Ougrée," with a capital of 8,000,000 francs, which in those days was equivalent to some £320,000, each company contributing about half. The combination was prosperous, and in 1896 the capital was increased to 25,000 shares, representing a value of 10,000,000 francs.

The "Société Anonyme d'Ougrée-Marihaye," by which name the company is now known, dates legally from April 30th, 1900, when the undertaking, the history of which we have sketched, absorbed the "Charbonnages de Marihaye" and increased its capital to 40,000 shares. The new concern was organised under three departments: the Marihaye Department, which at that time produced about 500,000 tons of coal per annum; the Blast-furnace Department, with four blast-furnaces producing 128,000 tons of iron, and a colliery producing 111,000 tons of coal annually; and the Steel Department, turning out 170,000 tons of Bessemer and Thomas steel, 18,000 tons of Siemens-Martin steel, and girders, rails, plates, sections, tires, axles, &c., to the amount of 151,000 tons. A fourth department was added in 1905, when the company took over the "Société des Hauts-Fourneaux de Rodange," increasing its capital to 75,000 shares for that purpose. Financial interests were subsequently acquired in the Fonderies Ketin, and in the "Usines à Tubes de la Meuse" at Flémalle-Haute in Belgium, as well as in the "Société des Hauts Fourneaux de la Chiers" and the "Forges de Vireux-Molhain" in France. At the present time, besides owning the Ougrée and Flémalle-Grande Collieries, the company is a large shareholder in the Bray, Six-Bonniers, Joudreville, Moustiers, Sexey, and other mines.

When the war broke out the Société d'Ougrée-Marihaye was one of the most powerful steel companies on the Continent. During the year 1913 the Ougrée plant alone produced 320,000 tons of cast iron and 500,000 tons of steel ingots. There were then at Ougrée eight blast-furnaces, about fifteen rolling mills, a tire and axle works and shops for constructional steel work. The Germans, when they occupied the country, were not content with utilising or destroying such plant as the necessities of war might justify. They followed the policy, at Ougrée as at other places, of systematically wrecking industrial establishments, either for the presumed ultimate benefit of their own manufacturers, or merely to terrorise the inhabitants of the occupied territory by exhibitions of frightfulness, and earned for their military organisation a disgust and hatred which will with difficulty be eradicated. When they were finally driven out of the country the fine and efficient Ougrée works were utterly wrecked. Four of the blast-furnaces had been completely destroyed, and the remaining four seriously damaged. Of the other plant carried away, destroyed or heavily damaged were two steel mixers, the Thomas steel plant, the slag crushing plant, five tube mills with boilers and engines, twelve rolling mills with boilers, power plant, furnaces, shears, &c., 150 machine tools, twenty cranes, 178 electric motors aggregating 4550 horse-power, 16 gas and steam engines aggregating 9400 horse-power, three locomotives, and shops covering 20,000 square feet of area. The Germans actually took away from the works 36,000 tons of raw material, 11,700 tons of finished products, 282 tons of copper, brass and belting; they broke up and sent away as scrap 43,900 tons of machinery and plant of various kinds, and took away 3745 tons of machinery and plant for use in Germany. Similar depredations and destruction took place at the French works of the company at Chiers and Vireux-Molhain, and at the Ketin Smelting Works in Belgium. The collieries fortunately did not suffer greatly during the occupation, and the same remark applies to the Rodange Department of the company in the Duchy of Luxemburg.

Many Boards of Management would have been disheartened by the situation which confronted the company when its devastated works were returned to it after the Armistice. The directors, however, took immediate steps to build up new works on the ruins of the old, and in view of the lack of raw material, the difficulties of transport and the countless worries of the times, they may be said to have achieved wonders. To provide funds for the reconstruction and re-equipment of their plant, they increased their capital in 1919 from 75,000 to 110,000 shares, and issued 40,000,000 francs worth of debentures. Within a year of the Armistice two of their blast-furnaces at Ougrée were working, and the Thomas and Siemens-Martin steel furnaces and an electric furnace were providing material for five sets of rolling mills. To-day the Ougrée works comprise six blast-furnaces, fourteen steel furnaces, rolling mills for rails, joists, sections, plates, &c., coke ovens with by-product recovery plant, cement plant and shops for bridge and constructional steel work. These works have a capacity of 40,000 tons of cast iron and 50,000 tons of ingots per month, and the output of finished products is as great as it was before the war. The pre-war policy of extending the interests of the company has been continued, and it has acquired, since the Armistice, shares in the United Differdange Steel Works, the Coke-Oven Company at Zeebrugge, the Belgian Chemical Products Company at Schoonaerde, the Ardennes Stamping Mills, and the mines of Amermont and Saulnes.

In connection with the reconstruction of its Ougrée works after the war, the Société Anonyme d'Ougrée-Marihaye decided to make provision, on a large scale, for storing and handling the raw material for its coke ovens and blast-furnaces. These latter were built on a bank, 18 m. high, running parallel with the river Meuse, and separated from it by a narrow strip of land. It was on this strip that the new storage plant was to be placed, and by cutting away the bank where required, a site 60 m. wide by about 400 m. long was provided. The works which were undertaken constitute a very notable example of reinforced concrete construction, both from the point of view of magnitude and design. They comprise four main portions,

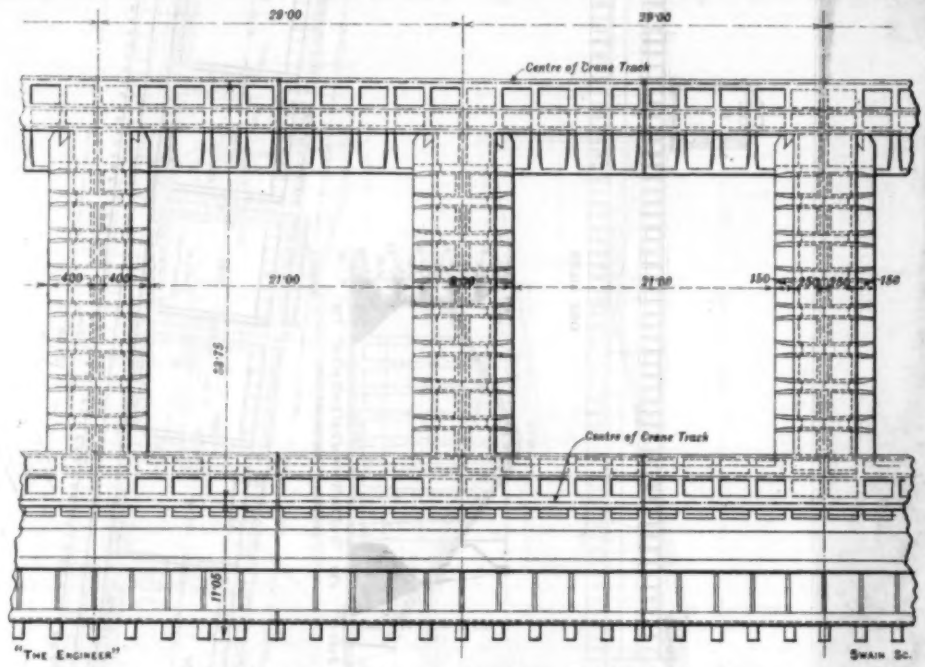


FIG. 1—PLAN OF TWO OF THE REINFORCED CONCRETE ORE BINS

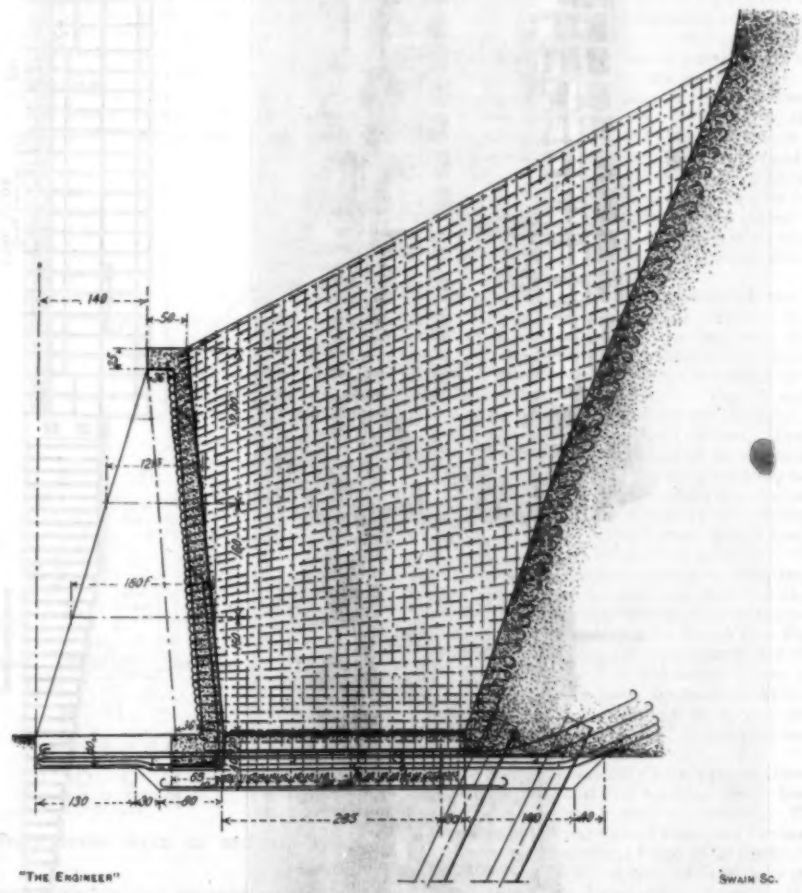
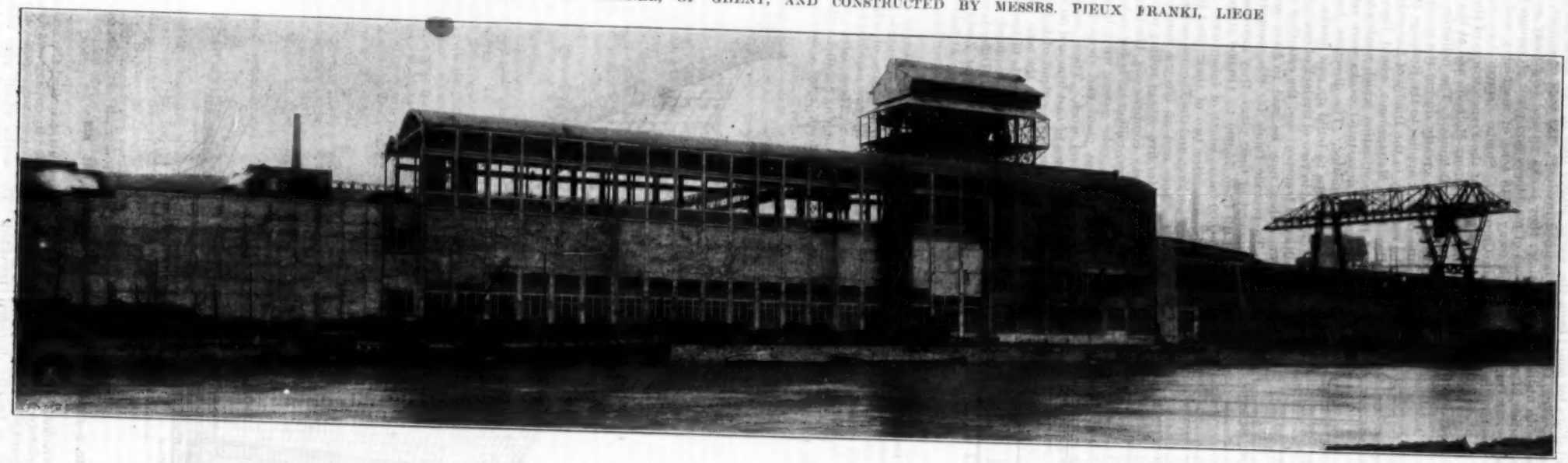
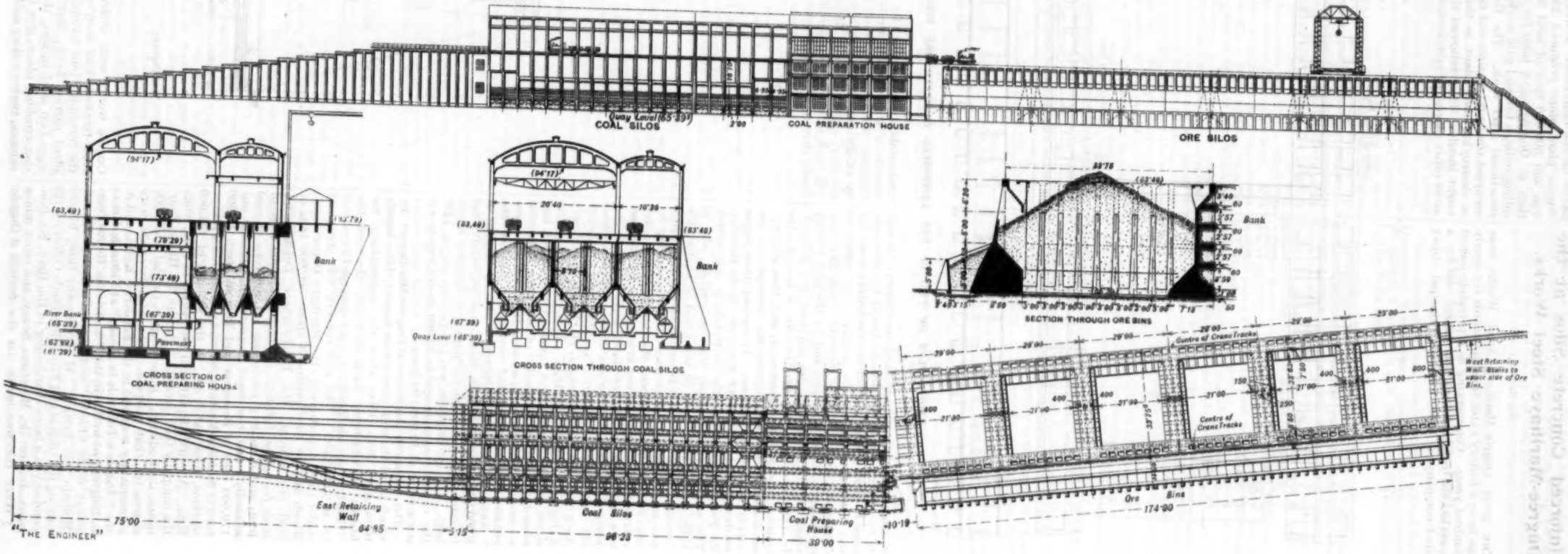


FIG. 2—CROSS SECTION THROUGH WAITING ORE BIN

REINFORCED CONCRETE ORE AND COAL SILOS AT THE OUGRÉE-MARIHAYE STEEL WORKS

DESIGNED BY PROFESSOR G. MAGNEL, OF GHENT, AND CONSTRUCTED BY MESSRS. PIEUX FRANKI, LIEGE



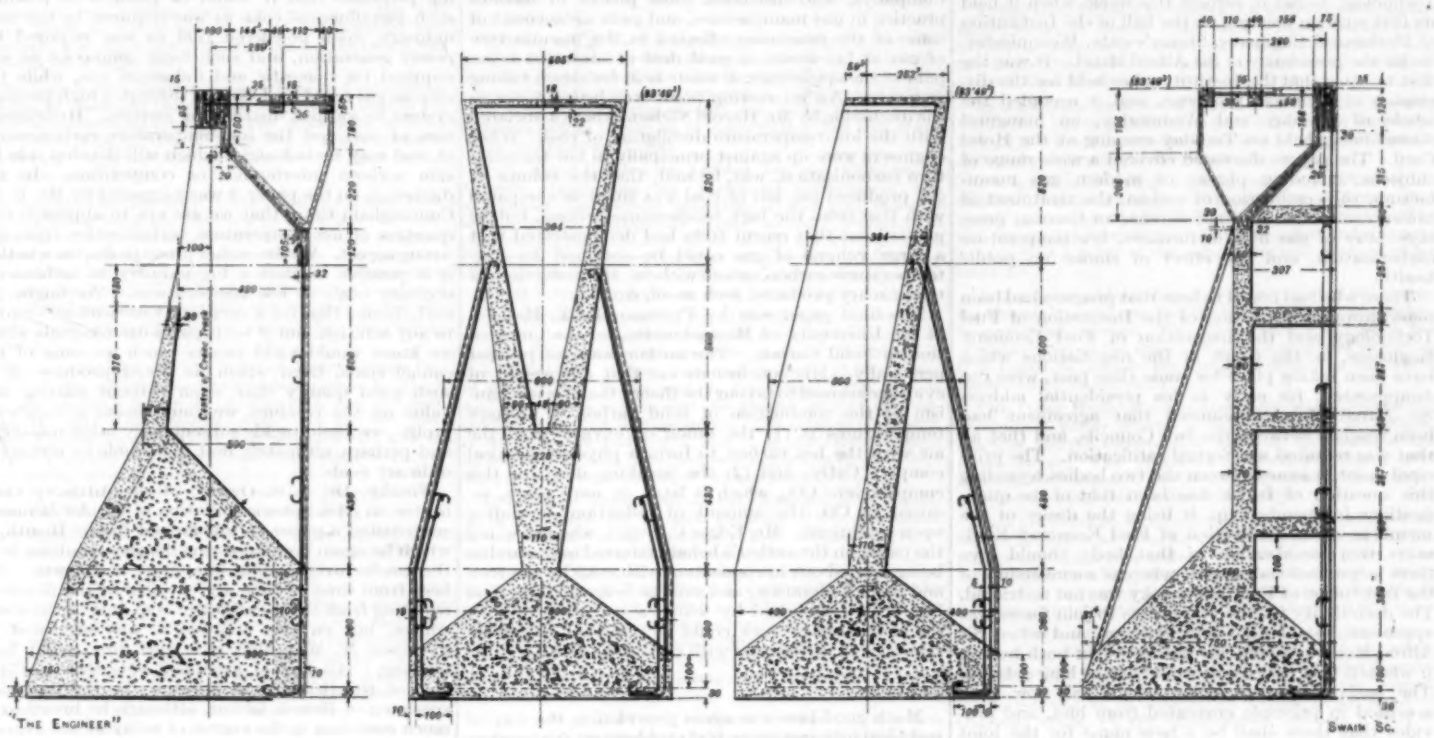


arranged successively along the site. Starting from the upstream end, there is first a number of ore silos with an aggregate capacity of about 100,000 cubic metres, or over 3½ million cubic feet. Following them is an enormous building for crushing and mixing coal for the coke ovens. This is succeeded by coal silos of a total capacity of 30,000 cubic metres; and, lastly, there is a great retaining wall to support the earth of the high level bank. The reinforced concrete work was designed by Professor G. Magnel, of Ghent University, and has been described by him in the *Technique des Travaux*, to which journal we are indebted for many of the details which we can now give of this important achievement in reinforced concrete construction. The contract for the whole of the work was awarded to Messrs. Pieux Franki, of Liége.

A view of the finished buildings is given on page 634, while the general arrangement of the work &c., is shown in the drawings on the same page, as well as cross-sections of the ore bins, the coal preparing house, and the coal silos respectively. There are, as will be seen, six ore-bins arranged side by side and having an aggregate length of 174 m., which are served by a travelling crane having a span of 33·756 m., or 110ft. 9in., and furnished with a grab of 20 tons capacity. Next to the ore-bins come the coal preparing house and the coal silos, both roofed over and carrying six standard-gauge railway tracks above the hoppers. The long retaining wall is seen to the left of drawings. The foundations for such structures required careful consideration, and preliminary borings showed the site to consist of a bed of made ground about 2 m. thick lying upon an irregular bed of clay varying from 2 m. to 6 m. in thickness, containing pockets of peat. The clay rested on a sloping bed of gravel. The subsoil water level was sensibly that of the river Meuse adjacent, and lay about 3 m. under the surface of the ground. It was clearly necessary to support the foundations directly upon the compact gravel, and the most practical way of doing that was by means of piles, as deep excavations in the water-bearing soil would have been troublesome and costly. It was finally decided to carry the superstructure on Franki piles, and 4959 of such piles, having an average length of 7·500 mm. were driven for the purpose.

THE ORE SILOS.

The ore in the silos rests directly on the ground, and is contained by walls 18 m., say 59·0ft., high. The silos are 180 m. long and 30 m. wide, divided into six bins, each 30 m. by 30 m. A plan of two adjacent bins is given in Fig. 1. The aggregate capacity of the bins is 100,000 cubic metres of ore, on the condition that the mineral is heaped above the crest of the walls to a total height of 28 m. above the ground level as shown in the cross-section given on page 634. On the river side, and at the foot of the great bins, are the smaller "waiting" bins, formed by a little wall 5 m. high and 180 m. long joined by a number of transverse walls to the large bins. The whole of the bins are designed to carry safely their maximum content of Swedish iron ore, weighing 3 tons per cubic metre. The sides of the large bins are really retaining walls, and by the use of special profiles a very advantageous and economical solution of the problem was obtained. All the walls of these bins are formed of buttresses placed about 3 m. apart and united by slabs and solid blocks of filling, of such a form that the ore, entering the spaces between the buttresses, helps by its own weight to stabilise the walls. A section through the "waiting bin" is shown in Fig. 2, while Figs. 3, 4, 5 and 6 give various sections through the walls of the main bins. The first of these—Fig. 3—is a section of the outer wall next to the Meuse, and against which is the waiting bin. Fig. 4 is the dividing wall between adjacent bins, Fig. 5 is one of the end walls, and Fig. 6 is the long wall separating the silos from the high bank. The relationship between the waiting bin wall—Fig. 2—and the main bin wall—Fig. 3—is shown in Fig. 7, which illustrates, moreover, how the weight of ore is used to assist the stability. The buttresses are placed at centres of 2·90 m. They measure 8·50 m. at the base and have a thickness varying from 1 m. at the bottom to 0·55 m. at the top. These buttresses are connected at their upper portions, first by a beam for carrying one side of the great travelling crane, which gives a vertical loading of 176 tons; secondly, by two beams for carrying a standard gauge railway track, on which



FIGS. 3 TO 6—SECTIONS THROUGH WALLS OF REINFORCED CONCRETE ORE BINS

75-ton mineral wagons can be taken; and thirdly by a sloping curtain wall to retain the ore heap. The buttresses are united at their bases by heavy masses of concrete, the centre of which, being merely filling material, is of a less rich mixture than the outer portions. Each bay of the wall is carried by six Franki vertical piles, which are surrounded by rectangular reinforced concrete piles driven in sloping directions, as indicated in Fig. 7.

According to figures given by Professor Magnel in *La Technique des Travaux*, the following data were adopted for purposes of calculation:—

Weight of ore per metre cube	3 tons
Weight of rich concrete per metre cube	2·2 tons
Weight of filling concrete per metre cube	1·5 tons
Angle of repose of ore	45 deg.
Friction angle of ore on concrete	22·5 deg.
Load per buttress due to crane	106 tons
Load per buttress due to trains	27 tons
Total weight of wall per 2·90 m. run	350 tons
Diameter of Franki piles	60 cm.
Inclination of square piles to vertical	25 deg.

These latter piles were 35 cm. by 35 cm. square, and

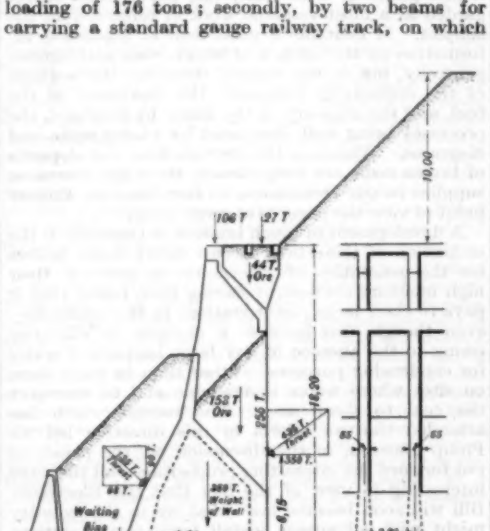


FIG. 7—OUTER WALL OF ORE BINS

were reinforced with four bars of 22 mm. diameter.

The construction of the wall allows two volumes of ore to act on it by a vertical force due to their weight; the upper portion held by the screen wall weighs 44 tons, and the main lower portion 153 tons. The outward pressure of the ore on the main walls can be resolved into a horizontal force of 350 tons and a vertical force of 255 tons. The ore in the waiting bins similarly exercises a horizontal thrust of 98 tons and a vertical force of 90 tons. It should be noted, however, that the wall of the waiting bins is tied in to the main wall at the level of the pile heads by a reinforced concrete connection—as shown in Fig. 2. This connection takes a tensile load of 57 tons per bay, which reduces the thrust of 98 tons on the main wall to 41 tons.

As regards the general stability of the structure, three cases may be considered. In the first place it will be assumed that the main bins are charged, the waiting bins empty, and neither crane nor train is on the section in question. The resultant of the loads passes through the point C in Fig. 7, and may be resolved as shown into a horizontal force T of 350 tons, and a vertical load N of 772 tons. The resultant is a force of 850 tons inclined at an angle of 25 deg. to the vertical, and for this reason the piles are inclined at that angle. Each of the nine piles sloping towards the Meuse carries, on the above assumption, a load of about 93 tons. This figure, which may be considered high, will be referred to later.

Supposing, in the second place, that the bins are loaded with ore as before, but that the crane and a train are standing on the section considered. The centre of pressure will then be at C_2—Fig. 7—and there will be a horizontal component of 350 tons and a vertical component of 905 tons. These give a resultant force of 970 tons, inclined at 21 deg. to the vertical, which is distributed as above, 92 tons on each of the inclined piles and 26 tons on each Franki pile.

In the third case, it may be supposed that the main bins are empty and the waiting bins loaded, the crane and train being over the section. The centre of pressure is then at C_1 and there is a horizontal force of 41 tons and a vertical force of 573 tons, which results in a load of 81 tons on each Franki pile and of 88 tons on the pile sloping away from the Meuse.

It may be thought that the loading on the piles is excessive, but it must be remembered that more extreme conditions than could be realised in practice have been taken as a basis of calculation. Thus in the first case considered above, it has been assumed that a heap of ore sloping at 45 deg. and overtopping the walls by 10 m., extended the full length of the walls. This is obviously very much on the safe side, because the maximum height of the heap can only ov-

for 10 m. at the centre of each 30 m. bin, on account of the effect of the cross walls. It is indeed probable that the average load, both on the inclined piles and the Franki piles, will never exceed 75 tons per pile, under any conditions of loading, and that may be considered reasonable.

The Institution of Fuel Technology.

The work of the recently formed Institution of Fuel Technology began in earnest this week, when it held its first autumn meeting, in the hall of the Institution of Mechanical Engineers, Storey's-gate, Westminster, under the presidency of Sir Alfred Mond. It was the first meeting that the Institution has held for the discussion of technical problems, and it occupied the whole of Tuesday and Wednesday, an inaugural dinner being held on Tuesday evening at the Hotel Cecil. The papers discussed covered a wide range of subjects, including phases of modern gas manufacture, the combustion of carbon, the treatment of brown coal—with special reference to German practice—laws of gas flow in furnaces, low-temperature carbonisation, and the effect of smoke on public health.

Those who had hoped to hear that progress had been made towards the fusion of the Institution of Fuel Technology and the Institution of Fuel Economy Engineers, as the result of the negotiations which have been taking place for some time past, were not disappointed, for early in his presidential address Sir Alfred Mond announced that agreement had been reached between the two Councils, and that all that was required was formal ratification. The principal point at issue between the two bodies regarding this question of fusion has been that of the qualifications for membership, it being the desire of the members of the Institution of Fuel Economy Engineers that membership of that body should give them a professional status, whereas membership of the Institution of Fuel Technology was not restricted. The desirability for the two bodies to join forces was appreciated on both sides, however, and when Sir Alfred Mond accepted the presidency of both bodies, it was felt that that result would not be long delayed. The basis of amalgamation which has now been accepted in principle emanated from him, and provides that there shall be a new name for the joint Institution, to be decided upon by a joint Council of the two bodies, and that the membership of the new Institution shall consist of four classes, including a class of Fellows, to be limited at the discretion of the new Council.

In the main, Sir Alfred's presidential address was devoted to an enumeration of some of the problems of fuel technology which have to be investigated, and he divided those problems into three heads, namely, fuel economy to be obtained from existing plants in actual operation; fuel economy resulting from the development of electricity; and the future developments of fuels, such as new uses and treatments of coal, oil and the elements. It was characteristic of the present time, he said, not that we were short of researchers in this country, but that a great deal of wasted effort resulted from duplication and overlapping, and the Government Fuel and Power Committee—of which he is chairman—hoped to be able to effect co-ordination. A point he made was that there was a tendency to pay a great deal of attention sometimes to the improvement of efficiency in power plant, at the expense of the works processes themselves. It should not be forgotten that in many industries, as, for instance, iron and steel production, the amount of fuel used for power raising was a mere bagatelle as compared with the amount used in the blast-furnaces, and economy in the latter direction might have far more important results than in the former.

Among some of the interesting suggestions he made, in expressing the hope that manufacturers would in the future face the scrapping of obsolete plant with more determination and courage than had been manifested in the past, was that we might need an entirely new system of accountancy in this country, inasmuch as the mysterious process by which accounts were kept hampered the progress of industry. The technicians and the directors of companies, he said, wanted to go forward, but progress was hindered by the accountant and auditor. Another suggestion was that the cost of research should be treated as part of the capital expenditure of a company, instead of being met out of profits. He had sat on the boards of companies when everybody was full of zeal and anxious to undertake research, but when they were told that the cost of it had to come out of profits it became impossible.

Sir Alfred defended the fuel technologist against any suggestion that might be made that the title was invented to enable some amiable gentleman to extract a special fee. The fuel technologist must devote himself to the utilisation of all kinds of fuel, must be able to decide upon the best form of fuel to use in given circumstances and what the financial results would be. His training was more specialised than was appreciated, and the field for development was becoming wider and wider.

The optimism usually displayed by Sir Alfred was not lacking on this occasion, and he concluded his address with a reminder that this country had nothing to be afraid of if it did the obvious thing. It had the men, it had the training, it could tackle any new problems that arose, and it had a class of labour which was extraordinarily adaptable, very highly skilled and trained, and immensely dependable. No special dispensation from Heaven was required; what was wanted was the common-sense application of knowledge and brains.

The remainder of Tuesday was occupied with the reading and discussion of papers, the first by Mr. T. Hardie (chief engineer to the Gas Light and Coke Company), who discussed some phases of modern practice in gas manufacture, and gave an account of some of the economies effected in the manufacture of gas at his works, a good deal of attention being paid to the application of waste heat for steam-raising purposes. An interesting point was brought out in the discussion by Mr. Harold Nielsen, who is associated with the low-temperature distillation of coal. What engineers were up against principally in low-temperature carbonisation, was, he said, that the volume of gas produced per ton of coal was small as compared with that from the high-temperature process, but he pointed out that recent tests had demonstrated that a large volume of gas could be obtained by low-temperature carbonisation without the reduction of the primary products, such as oil, &c.

The final paper was by Professor R. T. Haslam, of the University of Massachusetts, on the Combustion of Solid Carbon. The author was not present personally. His conclusions are that the weight of evidence seemed to favour the theory that the mechanism of the combustion of solid carbon at furnace temperatures is (1) the union of oxygen from the air with the hot carbon to form a physico-chemical complex CxOy, and (2) the breaking down of this complex into CO_2, which is later, in some cases, reduced to CO, the amount of reduction depending upon conditions. Mr. Edgar C. Evans, who presented the paper on the author's behalf, referred to researches being carried out in connection with coke by the Iron and Steel Federation, and said he believed a method had been established by which a valuation of coke for blast-furnace work could be obtained simply by reference to its reaction with carbon dioxide.

Much good fare was again provided in the way of technical information on fuel problems on Wednesday, the second day of the meeting. Perhaps the greatest attraction was the paper contributed by Sir Richard Redmayne, late Chief Inspector of Mines, on the Occurrence, Working and Treatment of Brown Coals, with Special Reference to German Practice. Having in view the fact that the technical literature existing on the working and treatment of lignites and brown coals is meagre, scattered and indefinite, probably owing to the concentration of interest upon the higher grade or true coals, this paper must be regarded as a most valuable work of reference on the subject. It contains a good deal of statistical information on the subject of brown coals and lignites generally, but in the main it describes the working of the deposits in Germany, the treatment of the fuel, and the recovery of the many by-products, the processes being well illustrated by photographs and diagrams. Whilst in the British Isles the deposits of brown coals are insignificant, there are enormous supplies in our Dominions, so that from an Empire point of view the paper is of great value.

A development of much interest in Germany is the utilisation of these brown coals direct under boilers for the generation of electricity, in spite of their high moisture content, it having been found that it pays to erect large power stations in the coalfields—even though that involves a decrease in efficiency owing to the absence of any large supplies of water for condensing purposes—rather than to erect them on sites where water is available and to transport the coal to those sites. The success which has attended German efforts in this direction led Sir Philip Dawson, in the discussion on the paper, to put forward the interesting proposition—all the more interesting in view of the fact that the Electricity Bill will soon become law—that we in this country might with advantage install large power stations on the coalfields, using cooling towers, and generating by the use of the low-grade fuels which are regarded as practically valueless—or were so regarded prior to the coal strike. His view is that any decrease of efficiency resulting from the use of cooling towers would be more than counterbalanced by the low price at which the fuel could be procured. He also pointed out that although the calorific value of this fuel is low, it is much higher than that of the brown coal used in Germany, and has a lower moisture content. The coal might be used in the powdered form, which would allow of the different grades being burnt without the necessity for a special grate area or a special arrangement inside the combustion chambers of the boilers.

Another paper submitted at the meeting concerned the Hydraulic Theory of the Flow of Gas in Furnaces, and described some of the most recent achievements in the design and construction of industrial furnaces. The author was Professor W. E. Groum-Grjimailo, Professor of the Petrograd Polytechnic.

A third paper, by Mr. S. McEwen, discussed the Low-temperature Carbonisation of Bituminous Coals and the place it should occupy as a developed industry in relation to existing industries. The author contended that the place for low-temperature carbonisation is in extending the amount of coal which can be carbonised before use by producing a solid product which is not subject to the limitations suffered by the solid products from high-temperature carbonisation. He predicted that attention to the conservation of our fuel resources would result in all carbonising industries being combined, so that the raw coal could be delivered to a carbonising plant which would be so provided with different carbonising processes that it would be possible to produce such metallurgical coke as was required by the steel industry, such powdered fuel as was required for power generation, and such lump semi-coke as was required for domestic and industrial use, while the surplus gas could be delivered through a high-pressure system to various distributing centres. Hydrogenation of coal and the low-temperature carbonisation of coal may be industries which will develop side by side without interference or competition. In the discussion on the paper it was suggested by Mr. E. H. Cunningham Craig that we are apt to approach this question of low-temperature carbonisation from the wrong aspect. We are rather prone to discuss whether it is possible to start a big industry in carbonising ordinary coals at low temperatures. We might, he said, discuss that for a very long time without coming to any solution, but if we began with materials which we knew would yield profits—such as some of the cannel coals, from which we could produce oil of such good quality that, even without putting any value on the residues, we could make a handsome profit—we could tackle subsequently other materials, and perhaps ultimately find it possible to utilise the ordinary coals.

Finally, Dr. J. S. Owens, of the Advisory Committee on Atmospheric Pollution at the Air Ministry, contributed a paper on Smoke and Public Health, in which he again pointed to the dangers resulting from the smoke overhanging our cities and towns. We hear from time to time a great deal of the ill effects resulting from the breathing of coal dust in the atmosphere, but on this occasion it was suggested by Professor N. Moss that that coal dust might be a blessing. His line of argument was that statistics showed the British coal miner to be the healthiest specimen of British labour, although he breathed as much coal dust in the course of a day as the average town dweller breathed probably in a month. In addition to coal dust, the atmosphere of our towns contains silica and other dusts, and the suggestion was that, inasmuch as silica dust is physiologically inert, and coal dust is physiologically active, when a person breathes a mixture of the two, the activity of the coal dust enables the lungs to get rid of the coal dust and the silica dust with it. This view led Dr. M. W. Travers, F.R.S., to suggest that something in the nature of "froth flotation" is going on in the lungs. Dr. Owens, however, pointed out that even if it could be proved that coal dust did no harm in the lungs, its presence in the atmosphere resulted in obstructing the sunlight and caused harm in that way.

This concluded the business of the meeting, which was one upon which the Institution might well be congratulated, especially as it was the first meeting it has held. The tendency to crowd too many papers into a limited time, and so stifle discussion, which is so often apparent at meetings of this description, was not noticeable on this occasion, and ample opportunity was given to all to express their views. Indeed, in order to permit of full discussion of the papers scheduled, the reading of two other papers, on Steam Power Production and on the Hydrogenation of Liquid Fuel, by Sir John Biles and Professor J. Tausz respectively, was deferred until the spring meeting.

ELECTRIC POWER SCHEMES.

The Municipality of Heidelberg (Transvaal) has recently signed an agreement with the Victoria Falls and Transvaal Power Company for the supply of the town's electrical requirements. Tenders are to be invited for the construction of two transformer houses and also for the equipment.

In Natal the Municipality of Glencoe has arranged to take current from the Electricity Commission's Colenso Power Station. The current is to be taken at the annex to the sub-station at 6600 volts three-phase, which is controlled by automatic change-over switches to a supply main switch. From this point it passes to a link chamber in the transformer house, where it passes to two truck-type high-tension switches fitted with automatic overload gear, which control two 75 kilowatt transformers, and is transformed from 6600 to 22-380 volts. This again is controlled through ironclad hand-operated oil switches. The street lighting is operated by time switch, and throughout the town there is overhead four-wire distribution, the system being divided into two sections and balanced. The present load is 40 kilovolt-ampère for lighting and some 40 horse-power for power.

The Alice Municipality (Cape Province) has decided that the suction gas plant in the town's power station shall be replaced by an oil-driven engine. For that purpose the Queenstown Municipality has been asked for an option on a Diesel engine which it is offering to instal at Alice. The Queenstown Municipality is to guarantee an output of 57½ kilowatts for ten hours continuously, and to renew liners and pistons, and all parts found to be defective to be put in order.

Railway Matters.

THE jury which inquired into the deaths of the six passengers instantly killed in the Rawmarsh disaster of November 19th returned a verdict of accidental death at the adjourned inquest on December 2nd.

IT is reported that Messrs. Pease and Partners propose to build a privately owned colliery line from Thorne, on the Doncaster-Goole line, to a wharf to be built on the Ouse near Goole. The line will be between 5 and 6 miles long.

THE concentration on the London and North-Eastern Railway of two express trains into one, *e.g.*, the 1.30 King's Cross to Leeds and the 1.40 to Bradford and Harrogate, also the 5.35 to Hull and the 5.45 to Leeds, was cancelled on Monday last.

THE East Indian Railway is embarking on a substantial lowering of passenger fares which will greatly benefit the public who travel on its line. The reductions will involve a sum of nearly Rs. 60 lakhs out of the revenues of the railway. It is hoped to introduce the new fares on and from February 1st, 1927.

AN unusual case was tried in the High Court last week. Hay was being burnt on the railway bank near an overbridge, and in the resultant smoke a collision occurred between two passing road motor vehicles. A passenger in one of the latter was hurt, and sued the railway company for damages. The Lord Chief Justice suggested that the real negligence lay with one or other of the two drivers. The jury returned a verdict for the railway company.

THE conversion of the 124 miles of narrow-gauge line between Luxor and Assouan to standard gauge, to which reference was made herein on October 29th, has now been completed, and was officially opened on the 3rd inst. Through trains between Cairo and Assouan will now be possible, and there will be no occasion to change at Luxor. The running time has already been cut down by four hours, and it is hoped to make another reduction of a further two hours.

THE inquiry into the collision during the dense fog on the evening of the 24th ult. at Gale-street, on the Tilbury section, London, Midland and Scottish Railway, was conducted last week by Major Hall. The driver of the second train admitted that he missed seeing the distant signal for Upney, but instead of, as laid down in the rules, assuming that it was "on," he proceeded, and then, unfortunately, he missed the home signal, and afterwards the starting signal also. Having failed to see those signals, he made a special effort to observe the distant for Gale-street, and finding it "on," he reduced his speed, but not in time to prevent a collision with the preceding passenger train, which was standing at Gale-street home signal.

THE death is announced of Mr. Francis Clarke Gamble, Provincial Engineer of Railways for British Columbia, as having taken place on November 13th. Mr. Gamble was born in Toronto in 1848, and studied engineering at the Polytechnic Institute at Troy, N.Y. After holding important positions in connection with several railways in Eastern Canada, he entered the service of the Dominion Department of Public Works in British Columbia in 1880, and in 1910, when the British Columbia Government was undertaking railway construction on an extensive scale, he was appointed Chief Engineer of the Provincial Department of Railways. He was the first engineer to be chosen President of the Canadian Society of Civil Engineers, and was a member of the British and American Institutions of Civil Engineers.

THE reports made by the London and Home Counties Traffic Advisory Committee to the Minister of Transport upon the public inquiries held by the Committee with respect to the travelling facilities to and from :—(*a*) North and North-east London ; (*b*) East London, have now been published, price 1s. each. The reports survey the position in the areas under review, and give an outline of the existing travelling facilities and the general flow of traffic. The evidence submitted at the public inquiries as summarised, and the Committee's findings are set out in detail. Maps are appended showing existing tube and surface railways, omnibus routes and tramway routes. In addition to dealing with the local conditions in the two areas in question the reports deal with certain general aspects of the problem of traffic in London as a whole.

IN this column of our issue of November 12th mention was made of a buffer stop collision at Sligo, on the Great Southern Railways. The report to the Department of Industry and Commerce by Mr. T. M. Batchen, the inspecting officer, has now been issued, and therein it is observed that the falling gradient of 1 in 120 for a length of 1¼ miles and the comparatively short level stretch of 330 yards into the terminus, necessitates the observance of special care on the part of engine-drivers in approaching Sligo Station. That such care has been exercised hitherto is evident from the absence of any previous case of collision with the buffer stops. It is presumed that this particular train was running at from 35 to 40 miles per hour when it got on to the 1 in 120 gradient, and that the driver delayed too long in shutting off steam and getting his train under control.

IN the House of Lords on the 1st inst. Earl Russell drew attention to the level crossing disaster at Naworth, near Carlisle, on August 30th last, and asked the Ministry of Transport what steps, if any, it was proposed to take with regard to railway level crossings in this country. Viscount Peel replied on behalf of the Ministry, and said that Colonel Mount's report was in the hands of the printer and would shortly be published. It stated that the layout at the spot was exceptional, and recommended that, notwithstanding the fact that that was the only accident known to have occurred at that crossing, the gates should be altered and interlocked with the signals. The average of accidents at similar—public road—crossings came to rather fewer than twenty a year, and several were due to a certain amount of carelessness on the part of the public, and could hardly be prevented by any sort of precautionary measures. The report has since been issued, and is referred to in our Seven Day Journal.

Notes and Memoranda.

A PAPER just issued by H.M. Stationery office, price 6d., deals with some experiments made by the Department of Scientific and Industrial Research on the estimation of free lime in hydraulic cements. Four methods of analysis are described, and their relative merits are pointed out.

A PROCESS for the prevention of mildew in textile fabrics, by the use of halogenated phenols, has been developed and patented by the British Dyestuffs Corporation. It has been found that whereas sodium phenate did not restrain mildew at 1 in 1000, parachlor sodium phenate restrained it at 1 in 5000, and trichlor sodium phenate at 1 in 40,000.

THE big bell of York Minster, known as Big Peter, which weighs 10¾ tons, has been taken down and sent to Loughborough to be recast, as it has proved to be so unwieldy that even forty men could not ring it. The weight of the bell is to be redistributed, and it is to be hung on ball bearings so that it may be properly rung. The cost of the work will be about £1500.

THE Agent-General in London for the Province of Ontario states that the Provincial Government has announced that, where desirable, it will give financial assistance to responsible people actively engaged in diamond drilling for coal or oil in the northern parts of Ontario. Experts consider that the possibilities of finding oil near the mouth of the Albany River are such as to warrant further exploration work by drilling.

THE British Commercial Agent at Batavia reports that, according to a Sumatra journal, the monthly production of resin and turpentine by the State plant at Takengon, in the Gajoelands, Achun, has now reached 15,000 kilos., of which about 20 per cent. is turpentine. The resin is sold to local industries, but the greater part of the turpentine is shipped to Amsterdam. The plant at Takengon is working day and night, and it is the Government's intention to enlarge it as soon as transport facilities permit the profitable exploitation of certain pine forests.

IT has been found that, on the explosion of an aluminium detonator, the metallic particles of the aluminium of the capsule at an extremely high temperature may initiate an explosion of inflammable gas or coal dust. The Secretary of Mines, after consultation with the Explosives in Mines Research Committee, has accordingly taken the precautionary step of making an Order, to the effect that no detonator other than an electric detonator in a copper capsule may be used in coal mines in which the use of "Permitted Explosives" is compulsory. No objection is raised to the use of aluminium-cased detonators in other mines or generally at quarries.

THE main conclusion to be drawn from an investigation made by the Department of Scientific and Industrial Research on the effect of illumination on the work of printers' compositors is that output does not reach its maximum daylight value—and errors and turned letters their minimum value—until an artificial illumination of the order of 20 foot-candles is attained, which, so far as can be ascertained, is a very much higher illumination than that usually found in printing offices at present. An increase of illumination *per se* appears, however, to be open to the risk of discomfort to the compositor arising from glare or from heat from the source, and the most suitable method of attaining this illumination without such inconvenience is now under investigation.

A DISPATCH from Oslo states that M. Hermod Petersen, the Chief Engineer of the Telegraph Administration, who for a number of years past has been carrying out experiments in connection with the broadcasting of portraits and pictures, gave a demonstration of his system of picture broadcasting on December 3rd, in the presence of the Minister of Commerce, high officials and the representatives of the Press. The demonstration is reported to have proved successful, and M. Petersen also mentioned his system for the telegraphic transmission of pictures through ordinary cables or wireless, and said that he did not doubt that the telegraphic service of the future would be based on the picture telegraphic system.

A NEW form of primer for blasting charges is, according to the *South African Mining and Engineering Journal*, being made at Germiston. A precast cylinder of paraffin wax having an offset hole of two different diameters is the basis of the new primer. The bottom of the hole is a neat fit for the cap, and a sixteenth of an inch of wax is left between the bottom of the hole and the lower end of the cylinder. The capped fuse is inserted in the cylinder and molten wax run into the upper large diametered hole, thereby sealing the cap and attaching the fuse and cap securely to the cylinder. Cutting and capping of the fuse and attaching of the wax cylinder are carried out in the factory, so as to reduce handling underground to a minimum. The primer is said to have several advantages over those made of wood.

A MESSAGE from New York states that a new testing machine for the inspection of surface finishes has just been invented by Mr. C. S. Stark, chief inspector of the Packard Motor Car Company. The machine is being employed in regular production to check engine piston pins and several other parts where perfectly polished surfaces are important. The new machine, according to its inventor, makes the inspection of a piston pin or other part with highly polished surface entirely mechanical and does away with the possibility of error in judgment. It is the result of years of experimental work. Microscopic photographs were used at first, but conclusive results were not obtained, even when pictures with 100 magnifications were taken. These photographs, however, did bring out an interesting fact, that a higher degree of surface finish produced a decidedly narrow sharp band of bright light in the photograph, while surface finishes of a lesser degree of polish produced a very wide band, much duller. This led to the use of a detector bulb which is similar to the cells used regularly in the work of sending photographs by telegraph. Such bulbs respond instantly to the most minute variations in light intensity. In the new machine the detector bulbs measure the light reflected from the surface under inspection and so give, mechanically, a measure of the degree of polish.

Miscellanea.

THE Mysore Representative Assembly has decided to expend Rs. 12 lakhs on irrigation works, to be completed within three years.

DURING last year New South Wales produced 609,418 tons of metallurgical coke, and, in addition, about 50,000 tons were imported from overseas.

THE four 10,000-kilowatt turbo-alternators for the power station in connection with the electrification of the Bombay suburban railways are being supplied by C. A. Parsons and Co.

IT has been decided to construct a hydro-electric metallurgic works at Corral, Chile, with 120,000 horse-power. Contracts have been made with the Bethlehem Pit and the Chile Iron Mines Company for the annual supply of 100,000 tons of iron ore.

IT is officially announced that the whole of the space in the British Industries Fair has been taken, with the exception of a few spaces rendered vacant in the Birmingham section by extension of the premises.

AN amphibian flying boat in charge of Pilot C. S. Caldwell, has returned to the High River, Alberta, after spending four months in the North-West Territories. The plane travelled between 6000 and 7000 miles, and was used to transport a party of three engineers who prospected for minerals.

IT is announced that there is every prospect of the charge for electric power from the Witbank plant, South Africa, being further reduced. The present charge is 0·442d. per unit delivered at the mine. With the proposed reduction it is hoped to provide the cheapest supply in the world generated by steam plant.

THE Perak Hydro-Electric Company, which is installing the biggest power scheme so far carried out in Malaya, has now started construction work on the banks of the Perak River. Two engineering electrical experts have arrived from England, the forerunners of a party of sixty-nine Europeans, who are due in January.

IT is proposed to carry out extensive reclamation work on the foreshore at Port Elizabeth, South Africa, for the purpose of improving railway access to the piers. The facilities for handling cargo are shortly to be added to by two mobile cranes, of the petrol-electric type, capable of handling 2 tons and of manœuvring in confined spaces.

THE Department of Overseas Trade has received a copy of the *Gazette of India* of October 23rd, in which appear certain amendments to the Indian Boiler Regulations. British firms interested may consult the amendments referred to on application to the Department of Overseas Trade, 35, Old Queen-street, London, S.W. 1.

IT is proposed to put up a nitrogen fixation plant with a minimum annual capacity of 3000 tons in Brazil. In this connection the *Chemical Trade Journal* remarks :—"The wide measure of prestige which British chemical plant and methods now enjoy in South American countries should be reflected in the proportion of the orders placed here in connection with the new developments, despite the competition which is certain to be met with on the part of American and German manufacturers."

TORQUAY Town Council decided on Tuesday, December 7th, to promote in the ensuing session of Parliament a Bill to confer further powers upon the Corporation in respect of its water, electricity, and harbour undertakings. Regarding the water undertaking, it was pointed out that the growing needs of the borough necessitated the seeking of another catchment area, and that they were tapping a new source at Fernworthy, near Chagford. There was no provision for the construction of a reservoir or dam, but a small weir would be constructed across the stream at a given point, and from it the water would be taken in pipes to the present storage reservoir.

THE work done so far on the Bridge River power development for the British Columbia Electric Railway Company, Ltd., has, according to the *Canadian Engineer*, consisted largely of surveys, investigations and preparatory work. The preliminary location survey for the 135-mile transmission line from Vancouver to Bridge River has been completed. The foundations for the dam site at Bridge River are being investigated by drilling and by bearing tests on the foundation material. A material yard has been graded adjacent to the Pacific Great Eastern Railway at Bridge River Station, and spur tracks and sidings installed for handling materials and equipment which will be shipped in over the railway. A contract has been let for widening the existing road and the construction of some new road from the railway at Bridge River Station into the Bridge River Valley. The work is well advanced, and it will be finished this winter if weather conditions permit. The first important item in the construction work will be the driving of a tunnel which will be about 2½ miles long. It is probable that the contract for this work will be let next summer.

A POWER plant of 20,000-kilowatt capacity is to be erected near Dike-road, Military-road, Chapei, Shanghai, in extension of the present plant. The present maximum demand is 5000 kilowatts, supplied through nineteen sub-stations aggregating a total capacity of 10,000 kilowatts. It is estimated that within the next two or three years the maximum demand will reach 10,000 kilowatts. Two horizontal turbo-generators, each to have a normal capacity of 10,000 kilowatts, 6600 volts, three-phase, 50 cycles, are being tendered for. The turbines which drive the generators are each designed for a steam pressure of 400 lb. per square inch, a total temperature of 750 deg. Fah. at turbine stop valve, and for a running speed of 3000 revolutions per minute. The power generated will be transmitted to Chapei district and extreme Western area, a distance of 21 miles, by two sets of overhead wires through two 10,000 kilowatts, three-phase, 50 cycles, 6600/33,000 volts, step-up transformers to three super sub-stations. These will in turn distribute to the nineteen existing sub-stations by underground cables, and thence to the consumers. All the sub-stations are linked up by the underground cables. The estimated cost of the complete plant and equipment will be about 2,000,000 dollars.

THE TEMPLEBOROUGH FILE MANUFACTURING WORKS OF SHEFFIELD STEEL PRODUCTS, LTD.

(For description see page 629)

FIG. 27—GENERAL VIEW OF HARDENING SHOP

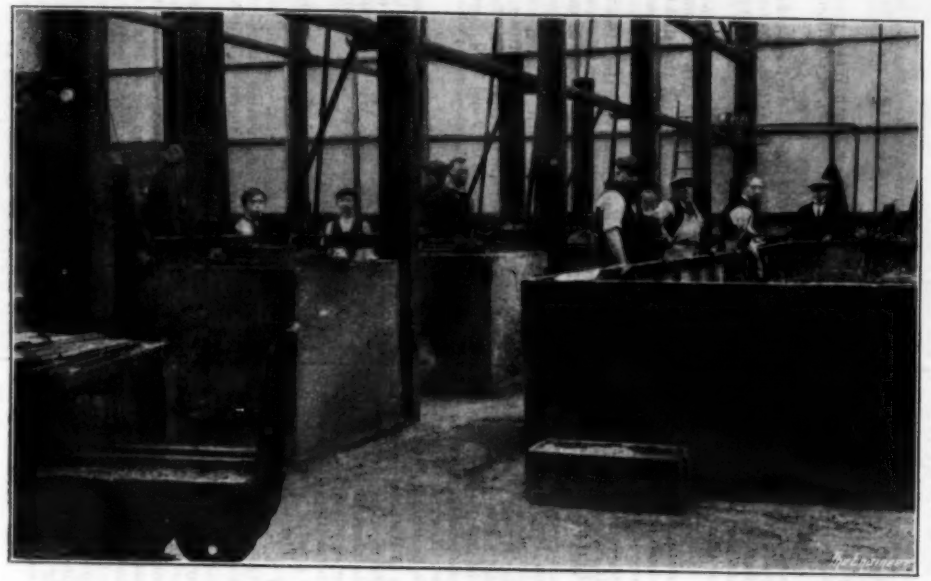


FIG. 28—QUENCHING BATH

FIG. 29—FILES BOXED AND LABELLED

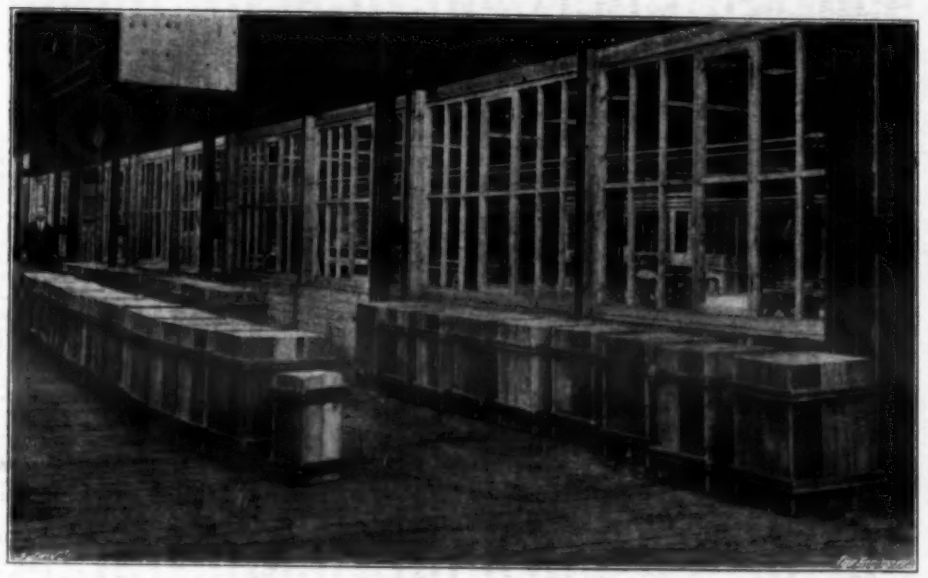


FIG. 30—FILES READY FOR DISPATCH

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C. JUTA AND CO., Johannesburg, East London, and Grahamstown.

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THE ENGINEER.

DECEMBER 10, 1926.

Our Engineering Prestige.

WE print in our correspondence columns a letter which deserves the attention of manufacturers. The object of the writer is to point out one of the causes which, according to his experience, renders British competition difficult in overseas markets. His contention, however, will bear a wider application. Our manufacturers know, to their cost, that it is not in foreign markets only that they find themselves in competition with their continental rivals. If their position there is prejudiced by the policy of working under license which our correspondent condemns, it is equally prejudiced in the home market. A buyer, whether he be British or foreign, cannot be uninfluenced in his decision by the reputation of the firms which submit tenders to him. The prestige of British engineering has been an enormous commercial asset to this country, and many a valuable order has been placed here almost entirely on the reputation for efficiency and reliability which British design has earned. It is in the interests of manufacturers individually, and it is also their duty to the industry as a whole, to maintain this prestige unimpaired. To do so they must lead, not follow. To construct machinery under foreign license is to place themselves deliberately behind their foreign rivals and practically to admit that they have to rely on the latter for designs and instructions. We do not, of course, deprecate the acquisition of patent rights for really valuable foreign inventions. Inventive skill is not confined to any one nation, and it would be worse than foolish to leave to other countries the exploitation of genuinely new ideas. Generally speaking, however, the question is not one of invention at all, but of design pure and simple. It is true that many designs are hedged round with an imposing list of patents, but it is probably only in rare cases that these would stand challenge, and even then it is questionable whether a simple alternative design would not serve as well or better. Before the war quite a number of English engine builders were paying royalties to a German "inventor" for the revival of a design of central-exhaust steam engine, which had been patented and constructed in this country years and years before. It was, moreover, a very simple thing, which called for no more special knowledge for its design than any capable engine draughtsman would possess. That the engine worked satisfactorily and was economical in steam consumption is no answer to the fact that the design was within the rights and competence of any engine builder to manufacture without a license. There may not be many cases so striking as this one, but the history of the steam turbine and of the heavy oil engine in Great Britain are hardly more flattering to our national pride. The steam turbine as a commercial machine was invented and developed here, yet for years afterwards this country was the happy hunting ground of foreign manufacturers with designs and licenses to sell. How much tribute our engineering firms paid in cash to their foreign rivals in respect of licenses will never be known, but in the aggregate it must have been enormous. This, however, is by no means the most serious aspect of the matter. It is the loss of prestige which is the greatest calamity. When once a firm adopts the policy of constructing machinery to foreign drawings instead of producing designs of its own, it can hardly be surprised if purchasers show as little confidence in its engineering capacity as it has shown itself. Besides being handicapped by the royalties which it has to pay, it progressively weakens its own position by the advertisement of its dependence upon outside designers, which each of its products bears. Can it be wondered at that orders become difficult to obtain in such circumstances, as compared with the case of a firm which leads instead of following.

It is easy to find excuses for the policy of manufacturing foreign designs under license. There are the drawings and calculations all ready, machines of the type in question have already been constructed, and, in theory, at any rate, manufacture can be begun at once without the expenditure of any time or money in the preparation of designs, or the conduct of experiments. This is the attractive picture, but how far is it true in practice? It is true that designs can be purchased, but no payment will purchase experience. One cannot hope to buy the really valuable knowledge for cash, even supposing that those who possess it are honestly desirous of imparting it, which is not always the case. Experience must be acquired by every manufacturer for himself; it is not a commodity to be obtained in any ready-made and serviceable form. Once gained in the only way possible, it is a source of strength and confidence, giving a self-reliance which dependence upon the instructions of others will never produce. Furthermore, in the origination of its own designs and their development to a commercial form, a firm creates for itself an intangible but very real asset. The new product is its own child whose characteristics are not only thoroughly appreciated, but whose birth and development have been a source of interest to the drawing-office and the shops. The staff understand it and are proud of it, whereas the product of imported designs is merely an alien and adopted infant whose teething troubles are not likely to be borne with the greatest patience. The history of British engineering during the last twenty years is crowded with cases where the alien child has died of inanition or of curable diseases through lack of sympathy. All the money paid for its adoption has been lost, and all the trouble caused by its intrusion has been fruitless. Worse than this, valuable time has been wasted and everybody concerned has been discouraged from developing an equivalent product along saner and more profitable lines. And of the imported inventions which eventually become satisfactory articles of commerce, in how many cases does one meet with the confession, "We have found it necessary thoroughly to re-design it, and you would hardly recognise the original article in its present form." An admission of this nature is much more creditable to the skill of the firm in extricating itself from a bad situation than it is evidence of its wisdom in purchasing the design in the first place. It may have succeeded in making something which will work properly, but it has lost the prestige which it would have secured had the article borne its name and imprimatur from the first. We believe there is much truth in the argument of our correspondent as to the loss of trade which occurs because so many of our manufacturers of oil engines, steam turbines and condensing plant have nothing but machinery of foreign design to offer. But the evil is even more deep-seated than would appear at first glance. Everybody acquainted with the inner working of manufacturing licenses knows that these generally carry with them an undertaking not to compete in certain markets or for certain classes of trade. The purchaser of a license therefore not only advertises to the world his disbelief in his own powers to originate a design, but he restricts his power of competition for profitable business. Agreements, moreover, are not unknown in which a manufacturer has actually bound himself to purchase and sell a certain quantity of machinery built abroad in the works of the firm which has granted the

license. Anything more inept in the interests of British trade could hardly be imagined.

The trade revival we all hope for is not going to be obtained by tactics such as these. When British engineering built up its reputation and established a commanding position throughout the world, it was not done by offering copies of machines designed on the Continent. Purchasers had to come to us because we led in design, and equivalent goods were unobtainable elsewhere. Our engineers had the courage and the initiative to develop new things, and they controlled the markets because their workshops were the only source of supply. Our industrial development is often wrongly attributed to our good fortune in possessing coal and iron near together. This may have been an assistance after development had commenced, but it was not the cause. Other nations had coal and iron and men as clever as our own, but we obtained our position because we had the courage to be first and to act before the rest of the world. It is enterprise which gives the lead, and more than ever so now that facilities of transport tends to equalise natural advantages. The proportion of the marine oil engines afloat whose design originated in a country without coal, without iron and without a seaboard, shows how much enterprise can do to build up an industry in the face of every natural discouragement. It may be more than a coincidence that the depression from which our engineering industry is suffering follows a period in which so many of our large firms have shown unprecedented activity in exploiting manufacturing rights from foreign articles. Had the same money and energy been spent in developing new products and designs, they might be leading, as their forerunners led, and receiving the profits and prestige of granting licenses to more backward firms, instead of struggling to secure trade with nothing but the designs of others to offer.

Naval Engineering.

In his presidential address to the Junior Institution of Engineers, which we reprinted with slight abridgment in our last issue, Sir Robert Dixon—continuing the work of Sir Henry Oram, a predecessor in the same chair—gave a general survey of the progress of marine engineering, with special reference to its application in the Navy, during the last eighteen years or so. It has sometimes been said that marine engineering is less progressive than land engineering; but although there are cases in which it has shown an unwillingness to depart from established practice—its retention of the Scotch boiler and its refusal to adopt superheating may be cited as obvious examples—it has, on the whole, been always abreast of contemporary land practice, and in some instances has led it. This observation is, we believe, particularly true of engineering in the British Navy, which, with rare exceptions and only with very good cause, has lagged behind developments which have taken place in ashore practice. We have only to recall its history of the water-tube boiler and of the steam turbine to see how progressive it has been under successive chief engineers. The "battle of the boilers" is now almost ancient history, and if the Admiralty made a mistake in the adoption of an unsuitable type of water-tube steam generator, that mistake was the result of a desire to be in the van of progress. In the case of the steam turbine it is sufficient to place the dates of the Dreadnought, 1906, and the Mauretania, 1909, side by side to see that the Navy did not tarry in the acceptance of that type of prime mover for very large powers. As a further example of its progressiveness we may note that the Admiralty is now, as Sir Robert Dixon mentioned in his address, experimenting with fairly large oil engines, a set of which with electrical transmission has been fitted in H.M.S. Adventure for cruising only and to give a large radius of action at low speeds.

Whilst it is clear, then, that marine engineering in the Navy has always been progressive, it must not be forgotten that in a sense it is hampered by conditions which do not obtain to the same degree in the mercantile marine. Many of those conditions are, in greater or less degree, inimical to the highest fuel economy, and the success with which they have been circumvented is a good measure of the efficiency and progressiveness of Admiralty engineers. Take, for example, the following striking facts from Sir Robert Dixon's address. There is an interval of roughly ten years between the Lion and the Hood. In that period the direct turbine had given place to the geared turbine, the large tube water-tube boiler to the small tube boiler, and coal to oil fuel. The result is remarkable. On the same floor space, and with the same machinery weight, the turbines of the Hood develop just twice the power of the Lion's turbines. This really astounding economy of material is attributable in the main to oil fuel, by the adoption of which the employment of very large boiler units—boilers of 10,000 shaft horse-power are common naval practice to-day—has been rendered possible. On the subject of Navy boilers Sir Robert had a good many interesting things to say. It was satisfactory to hear from him that boiler tubes are no longer drawn from foreign steel, since British steel makers have succeeded in meeting the requirements with, it would seem, complete success, for if they are properly looked after and properly treated, the tubes of small tube boilers have an average life under peace-time conditions of ten years. As their original thickness ranges from ·104in. to ·128in., that result could hardly be bettered. But as progress is made towards the solution of condenser tube corrosion, and with the help of the closed feed circuit, both of which will almost remove any possibility of impurities entering the boiler, it is anticipated that generator tubes will have a life not less than that of the vessel herself. Oil firing has, of course, brought with it its own secondary problems, one of which is to find satisfactory refractory bricks which are not of excessive weight. The present bricks weigh 126 lb. per cubic foot. In this connection it is worth quoting Sir Robert's own words: "Given the proper operating conditions, the pressure parts are practically free from maintenance charges within the tube life given, and the repairs are practically limited to those necessary to maintain the efficiency of the brickwork lining and furnace fittings, which, owing to the high furnace temperatures, require regular attention and timely repair as the need arises." The interdependence of all parts of a steam plant is never better seen than in the exacting conditions of naval engineering. On land there is not as a rule that imperative necessity to regard the plant as a single unit which is imposed upon marine plant by the absence of fresh water. The life of the boiler depends upon the absolute exclusion of impurities, and particularly of oily water, and in consequence the reciprocating steam engine for auxiliaries is doomed. As pressures continue to advance difficulties of lubricating such engines increase and the chance of oil entering the closed feed system augments. The turbine auxiliary is therefore making marked progress. With the improvements in design and economy which we have endeavoured to indicate the steam plant holds its own for naval work, and whilst admitting all the good features of oil engines, Sir Robert is plainly of opinion that it is not suitable for the propulsion of big ships of war. His discussion of the whole question occupied rather over a column in our last issue and contains in a condensed form a very interesting review of the *pros* and *cons*. We commend it to the attention of our readers with this single quotation:—"The further prospects of the oil engine," he says, "are received with considerable enthusiasm in many quarters, but I believe that this optimism is not entirely shared by those in close touch with the technical problems."

The last words of Sir Robert's address, which fitly rounded off his foreshadowing of the principles which must direct future endeavours, are worthy of the deepest consideration. They are as follows:—"The pooling of technical data and experiences of individual commercial undertakings to a much greater extent than in the past is greatly to be commended, and if this can be attained in an increasing degree it can hardly fail to lead to speedier and more certain progress in the elucidation of the increasingly difficult problems with which we are confronted." In that sentence there is a text for a whole paper. From his position Sir Robert Dixon has opportunities of acquiring knowledge about happenings which are jealously hidden from other people. There is far too much secrecy about failures and mishaps, and the engineering profession and industry would benefit to an incalculable degree if difficulties, common frequently to many firms at the same time, were openly discussed. The practice is to hush up all such problems, and instead, we will say, of two rival firms of shipbuilders or turbine makers coming together to face a difficulty which both have had to face, each hammers at it alone in the hope of scoring off its competitor. This is a common practice, and whilst there is a natural human bent in it, it is, we believe, fostered rather by the commercial than by technical people. Where the country's interest is involved it ought to be impossible. Unfortunately, the Admiralty itself has led in the practice of secrecy, and it is hardly surprising if its contractors follow suit. It could, nevertheless, do something in some cases to remove a form of rivalry for which there is little or nothing to be said, and it might induce amongst British manufacturers as much willingness to discuss common problems as is found in Germany and America.

Literature.

Brassey's Naval and Shipping Annual, 1927. Edited by Sir Alexander Richardson and Archibald Hurd. London: Wm. Clowes. 1927. 25s. net.

There is scarcely any subject pertaining to naval and shipping affairs which does not find adequate treatment in the new edition of "Brassey," the thirty-eighth of the series. As the editors remark in their preface, "Far-reaching changes in the application of physical science to sea transport, as well as to sea defence, are taking place, while at the same time political influences are reacting, to an extent which is little appreciated, on the services of merchant shipping in all parts of the world, as well as upon the distribution of the men-of-war of the maritime Powers." These movements are well reflected in the present volume. Of the eighteen chapters, ten deal with questions of naval interest, the others being devoted to merchant shipping. Commander C. N. Robinson contributes his usual survey of the British naval forces, and, in a series of instructive tables, is able to show what large economies have been effected in the naval administration. Much interest will be aroused by Commander Ichiro Sato's explanation of Japanese naval policy, which he shows to be essentially defensive. Japan has now become so dependent on imports from overseas that a navy strong enough to protect this trade is vital to her existence. Her naval policy, in short, is dictated by much the same motives as our own. In their study of comparative naval strength the editors have found no evidence that the cessation of battleship building has unduly stimulated the production of other warships.

Sir George Thurston, who in previous issues had suggested possible developments in battleship and cruiser design, now turns his attention to the destroyer, which he considers to have fully justified its perpetuation. He advocates a type somewhat larger than our present flotilla leaders and mounting a far heavier armament. The following are the chief points of the design:—Length, 400ft.; displacement, 2900 tons; speed, 36 knots; armament, ten 4·7in. guns, twin-mounted; at least sixteen 40 mm. A.A. guns, sixteen 24in. torpedo tubes. Such vessels would, however, be very expensive, and we think that a smaller and cheaper type would be preferable, having regard to the large number of destroyers that the navy requires. Lieutenant-Commander A. C. Bell has an interesting paper on cruiser design from the sailor's point of view. Captain Alfred Dewar offers some incisive criticism of the proposed Ministry of Defence; and Captain E. Altham shows how national industry profits by naval construction. The Merchant Shipping Section opens with the customary review of the world's commercial fleet by Sir Westcott S. Abell, of Lloyd's Register. Without attempting to minimise the serious difficulties which continue to hamper shipping, he is yet hopeful that conditions will improve, though he again emphasises the necessity of weeding out obsolete tonnage and restoring the merchant marine of this and other countries to the pre-war state of efficiency. Sir J. H. Biles writes on high-pressure steam turbines, with special reference to the experimental steamer King George V., which he believes to have opened a new era in steam engineering. He anticipates the adoption of the system in high-speed Atlantic liners and in warships of every class, pointing out that for warships it has the dual advantage of increasing speed and radius of action. Mr. Walter Runciman has a lucid article on the economics of British shipping; Mr. John P. Taylor treats of the passenger ship as a cargo carrier, and Mr. James Richardson chronicles progress in marine machinery. Many pages are filled with silhouettes of warships and merchantmen, but while the latter are of interest, we fear that the former are on too diminutive a scale to be of much value for purposes of recognition. In the reference sections of the book the statistics and other data have been brought up to date. Whenever, therefore, a question relating to naval or shipping matters requires an answer, "Brassey" may be consulted with perfect confidence. The new volume is in all respects up to the high standard of its predecessors.

Jane's Fighting Ships, 1926. Edited by Oscar Parkes and F. E. McMurtrie. London: Sampson Low, Marston and Co. 1926. Price 42s. net.

The new volume of this famous naval encyclopædia is enriched by numerous photographs of very recent date, depicting all the latest ships of the British and other navies. Three views of H.M.S. Nelson are given, besides a diagram, and these, together with the particulars which the Admiralty has released, enable a clear impression to be formed of this ship and her sister, the Rodney. The revolutionary nature of their design is indicated by the distribution of the

big guns, all of which are mounted forward; the withdrawal of the machinery spaces towards the stern, and the substituion of a huge control tower for the tripod foremast, which was so prominent a feature of earlier ships. In gun power, and possibly in protection also, these ships are unequalled. Their speed still remains an official secret, but if the constructors have been able to go above 23 knots they will have performed wonders. In view of the large programme of cruiser construction which is now under way, it is satisfactory to have plans and particulars of the "Kent" class. The design appears to have been well thought out. It provides for a displacement of 10,000 tons—exclusive of fuel—a speed of 32 knots, and a main armament of eight 8in. guns in twin turrets at bow and stern. As the freeboard is high and the hull flush-decked, the ships should be more weatherly and comfortable than the low-lying cruisers that were built during the war. Including the Canberra and Australia for the Commonwealth Government, eleven ships of this type are now under construction, and two more are to be laid down before next April. Another interesting addition to the Fleet is the cruiser-minelayer Adventure, which began her trials in November. Her machinery is believed to consist of Parsons turbines, with Diesel engines for cruising purposes, but no details of the installation have so far been given out. Her present armament of four 4·7in. guns is so inadequate that we hope "Fighting Ships" is well informed when it suggests that five 5·5in. guns may eventually be mounted instead. The number of mines carried is said to be one thousand. Some excellent views are given of the battleship Warspite, as reconstructed, with the fore funnel trunked into the second and the bridges rebuilt. The effect, if rather odd, is not unpleasing.

Turning to foreign navies, visual evidence is afforded of the modernisation programmes which are a feature of post-Treaty development. All the six Dreadnoughts of the French Navy have been rebuilt, involving a complete change in their appearance. In the six oldest American battleships the uptakes are led into a single funnel, new masts have been stepped, and aeroplane catapults installed. Japan has transformed the Nagato and the Mutsu, which now have much the same funnel arrangement as the Warspite, and her other battleships are a mass of tophamper. The new French cruisers, destroyers, and submarines built since the war are illustrated for the first time. The surface craft are beautifully modelled, especially the destroyers of the "Simoun" class, and the majority have done well on their steam trials. The latest type of French leader, now being built displaces 2650 tons, is engined for 36 knots, and armed with five 5·5in. guns. It is therefore a light cruiser in all but name. Perhaps the most striking vessels portrayed in the book are the Japanese cruisers Furutaka and Kako, remarkable alike for the weight of armament in proportion to tonnage and their extraordinary appearance. Displacing no more than 7100 tons, and capable of 33 knots speed, they carry six 7·5in. or 8in. guns singly mounted on the centre line, three of the gun-houses being forward and three aft, with the middle one of each group superimposed. The first and second funnels are trunked together, and immediately abaft the third is an aeroplane hangar and a catapult. To us these ships appear top-heavy, but if they are reasonably good sea boats their designers have opened up a new vista of possibilities as regards cruiser construction.

There is a certain sameness about most of the 10,000-ton "Treaty" cruisers now being built at home and abroad. In England, France, and Italy a main armament of eight 8in. guns has been adopted, but Japan is putting nine into her new ships, and the American type is to have ten. Speeds vary from 32 to 34 knots, and armour protection is, of course, very scanty, though our ships are credited with a 4in. deck amidships. Submarines show a progressive increase in dimensions. Larger boats than the X.1 are now on the stocks in America, France, and Japan, and the coming of the real submarine cruiser, with high speed, heavy armament, and almost unlimited endurance, would seem to be only a question of time. The identification of warships at sea will be rendered more easy by the stippled silhouettes which are gradually replacing the old block elevations. In the British section the change is already complete, and there can be no question as to the superiority of the new system. In order to mark the thirtieth year of publication a brief account of the genesis of "Fighting Ships" is given, and specimen pages from the first edition are reproduced. The present volume does credit both to editors and publishers.

High-pressure Steam for Marine Use.*

IN the paper which was presented by Director O. H. Hartmann at the recent annual meetings of the Schiffbautechnische Gesellschaft, a general review of the present position of high-pressure steam practice is given, and it is sought to indicate in what way the experience now gained can best be applied to marine practice. Director Hartmann entitles his paper "Possible Developments of High-pressure Steam for Ship Propulsion." After referring to earlier papers on the same subject by Dr. G. Bauer and the experimental work of Wilhelm Schmidt, he goes on to show the great advance in the direction of higher steam temperatures and pressures which has taken place within the last five years. As an instance of such progress, some figures are quoted from the returns of the German Association of Boilermakers, which show that in the year 1924 the boilers of the various electricity works in Germany totalled some 2,000,000 square metres of heating and superheater surface, giving an average heating surface of 440 square metres, or about 4736 square feet. Of the aforementioned aggregate, only about 2·4 per cent. of the boilers were built for pressures higher than 20 atmospheres, or about 280 lb. gauge. As a contrast to such a figure, a report of the German Association of Water-tube Boilermakers is quoted. It shows that in the period 1922–1924 20 per cent. of the boilers ordered in Germany were for pressures of over 280 lb. gauge, whilst in 1925 that proportion was increased to 65 per cent. During the present year over 37 per cent. of the boilers ordered are for pressures above 30 atmospheres, or 427 lb. gauge, while some of the units have a total heating and superheater surface of 2500 square metres, or nearly 27,000 square feet.

The author states that at the present time over 133 boilers in German industrial works are designed for gauge pressures of 427 lb. Progress, he further says, has been greatly helped by the production of solid forged and welded boiler drums by such firms as the Fried Krupp A.G., Essen/Ruhr, the Press und Walzwerk A.G., Reizholz, and the Vereinigte Stahlwerke A.G. Abt., Thyssen Mülheim/Ruhr. Within the last two years about 600 drums of these two types have been made and delivered. Apart from the already existing high-pressure installations at the Schmidt Experimental Station at Wernigrode and the Schmidt-Borsig plant at Berlin-Tegel—both designed for a pressure of 60 atmospheres, or 868 lb. gauge—further plant of the Schmidt type is being erected at a Berlin brewery for 48 atmospheres, or 690 lb. gauge, while several electrical undertakings are considering the use of steam at pressures up to 40 atmospheres, or 574 lb. gauge. After alluding to recent developments in Sweden and America, the author instances the Henschel double-pressure locomotive designed for a working pressure of 60 atmospheres, or 868 lb. gauge, and the Clyde passenger steamer King George as outstanding events of the year.

The earlier part of Director Hartmann's paper is devoted to a consideration of the gain to be obtained by raising initial steam pressures and temperatures and re-superheating. As an example of such practice, the author recalls the results obtained from Schmidt's 1921 experimental engine with four-stage working in which, with steam at an initial temperature of 465 deg. Cent., with two-stage re-superheating and a 96 per cent. vacuum, a steam consumption of 2·26 kilos., or, say, 4·98 lb., with a heat consumption of 2000 kilo-calories per indicated horse-power per hour was obtained. Curves are then shown for increasing initial pressures of from 15 to 100 atmospheres, or, say, 216 lb. to 1465 lb. gauge, with a 95 per cent. vacuum under the following conditions. The live steam would be superheated to 375 deg. Cent. at the lower pressure and 475 deg. Cent. at the higher pressure, and three-stage working, with two-stage re-superheating and feed-water heating would be employed. A thermal efficiency of 80 per cent. is assumed for each stage, with a mechanical efficiency of 96 per cent., and it is further assumed that the condensate would be returned to the circuit as feed water at a temperature of 32·6 deg. Cent. The main results of this investigation are given below:—

Heat Consumed per Effective Horse-power.

Initial pressure—				
Atmospheres	15	30	60	100
Pounds per square inch gauge	216	427	868	1465
Heat consumed, k.-cal. per H.P. eff.	2255	2032	1830	1700
Percentage saving	—	9·9	18·85	24·6

By the figures given above it is made clear that the theoretical percentage saving on the amount of heat consumed per effective horse-power increases with higher initial pressures. Thus an initial pressure of 40 atmospheres, or 574 lb. gauge, can in no way be looked upon as a limiting figure.

Between the gauge pressures of 427 lb. and 868 lb. per square inch the saving is 9 to 10 per cent., while between 427 lb. and 1465 lb. gauge, it increases to 15 and 16 per cent. The author cites thermal efficiencies of 90 per cent. relatively to indicated horse-power, which have been obtained with high-pressure reciprocating steam engines, and he states that if the high-pressure drop be utilised in such cylinders and the low-pressure drop in a turbine, then the above figures can still be improved upon. Assuming coal at 7500 kilo-calories per kilogramme, he works out a fuel consumption of 0·2675 kilo. per effective horse-power, or 0·2 kilo. for oil firing. If the lower grades of fuel oil be used, even though the high efficiencies mentioned above are not reached, the result would still be comparable with those of the motor vessel. It will be noted that in the first column of the above table a figure of 2255 kilo-calories per effective horse-power is given. Ideal machinery installations such as those assumed are not yet built, and even if a good turbine figure be taken, then it would be more likely to be about 2600 kilo-calories per effective horse-power. The higher pressures of 868 lb. gauge and 1465 lb. would show, when compared with this figure taken from present-day practice, gains of 30 and 34·8 per cent. respectively in the two cases. The ideal figures given do not take into account auxiliary machinery, but it is suggested that such machines should be driven by pass-out steam or by current derived from Diesel-electric generator sets.

The author points out that the very attractive figures above given are only to be reached if the cost of the new high-pressure machinery is not prohibitive, and, further, reliability of operation must always be the first consideration. For this reason, he suggests that it would be unwise to begin with large installations, and he proposes that experience should first be gained with a river vessel or a small cargo vessel with engines of only a few thousand horse-power.

In the remaining part of the paper the author deals with high-pressure boilers and several drawings are given for marine type boilers designed for a working pressure up to 65 atmospheres, or 940 lb. gauge, and having a steaming capacity of about 20,000 lb. to 25,000 lb. per hour. One of these boilers is a two-pressure boiler designed on the lines of the Henschel-Schmidt locomotive boiler. It is demonstrated that the weight of such boilers is in no way excessive, and the cost should not be higher but rather lower than that of ordinary superheated steam or water-tube boilers. Designs are also put forward for a high-pressure marine reciprocating engine with five stages of expansion and intermediate re-superheating. Director Hartmann is of the opinion that turbines will always be used for large powers, but pending the development of a reliable high-pressure turbine a reciprocating engine of the type described can, he says, effectively be employed for marine service, even if the lower ranges of expansion are arranged to take place in a low-pressure turbine. With a reciprocating engine installation of the type mentioned, it is estimated that, with coal of a heating value of 7500 kilo-calories per kilogramme, the steam consumption, including that of the auxiliary machinery, would not be larger than, say, 0·43 kilo. per indicated horse-power, compared with a figure of, say, 0·58 kilo., which may be taken to be representative of good superheated steam turbine practice. Such a result would give a saving of about 26 per cent. on fuel, which the author regards as a real saving, provided that the upkeep and running costs of a high-pressure installation are not greater than those of a superheated installation.

In concluding his paper, Director Hartmann says that he is well aware that the engine and boiler schemes put forward are capable of improvement in details, but he regards them as fulfilling the object of the paper, which was to examine possible developments in high-pressure steam practice, and not to put forward already perfected schemes.

* Schiffbautechnische Gesellschaft. Berlin meetings.

Obituary.

MR. H. A. SLACK.

TECHNICAL journalism has suffered a severe loss in the death of Mr. H. A. Slack, which occurred at his home in Hove on Sunday last, after a very short illness. Mr. Slack was a familiar figure at technical meetings and congresses in all parts of the world, and had a very large circle of acquaintances and friends. He was the most competent technical reporter in London, for he brought to his subject a good deal of scientific knowledge which he had acquired in a varied career. He was born in 1862, and was at one time a lecturer at the Working Men's College, and he was secretary to Mr. W. S. Caine when Civil Lord of the Admiralty, and for some years to Sir Norman Lockyer at the Solar Physics Laboratory, South Kensington. He took up journalism many years ago, and practised it with tireless energy. He had the happy characteristic of never getting flurried even in the most trying moments, and never seeming to be in a hurry. Yet he was always ready to go anywhere and do anything at a moment's notice. He was universally trusted by the Editors for whom he worked, and by those whom he had to meet in the course of his profession. Although a free-lance journalist he was widely known as a reporter on special subjects for the *Times*, the *Times Engineering Supplement*, and THE ENGINEER.

A DETAILED account of an apparatus designated "a wave-speed camera," is given in a paper by W. Payman and W. C. F. Shepherd, entitled "The Pressure Wave Sent Out by an Explosive. Part II." (Safety in Mines Research Board Paper No. 29, H.M. Stationery Office, Adastral House, Kingsway, London, price 1s. net). This apparatus was devised to obtain records of:—(*a*) The rate of propagation of the shock—and pressure-waves sent out by an explosive; (*b*) the rate of projection of the flame and products of detonation; and (*c*) their relative positions at each instant after the shot has been fired. Experiments are described illustrating the operation of the apparatus, using detonators as the explosive charge. The experiments have shown that the flame of a No. 6 detonator never comes into contact with the external atmosphere, being always surrounded by a "blanket" of non-combustible gases, the products of detonation. This fact explains the inability of the flame of a detonator to ignite a mixture of firedamp and air.

The Re-signalling of Cambridge Station.

CAMBRIDGE Station, which is the property of the London and North-Eastern Railway Company, is singular among the big railway stations in this country in that there is perpetuated the one long platform to serve both up and down trains which was, in the past, very much favoured, in particular by the Great Western, as at Reading, Didcot, and Gloucester.

The platform at Cambridge is 600 yards long, and, as seen in the accompanying diagram—Fig. 1—it is served by a platform road which is common to both up and down trains. Down trains pass through the through road A A just south of the South Box, whilst up trains enter on to the platform road by the crossover road D just south of the North Box. Up trains depart by way of the through road C and enter on to what becomes the up main line. Paralleling the platform road is a through road which is a continuation of the up main line. It, like the platform road, is common to up and down movements from the double slips B, near the South Box, to the crossover road E E. In addition, there is a scissors crossover road F F, G G which allows a down train that has stood at the south end of the platform to go out by F F and to pass a train standing at the north end—the former would, in that event, reach the down main by the crossover E E; would allow a down train to enter by the through road and go by G G to the north end of the platform; would allow an up train that has stood at the north end to go out by F F and to pass a train standing at the south end; would allow an up train to pass off the through road, through F F and reach the platform at the south end. There are also two bay lines at each end of the station: Nos. 2 and 3 at the south end and Nos. 5 and 6 at the north end. All these bays are signalled for both arrival and departure.

To control the movements through the station and to work the connections shown on the diagram two signal-boxes were required at the south end, besides a centre box to work the scissors crossover and two boxes at the north end—five boxes in all. These have now been replaced by one box at the south and one at the north end. Both are operated by power on the all-electric system associated with the British Power Railway Signal Company, Ltd., of Caxton House, Westminster, S.W. 1. The South Box contains a frame of 128 levers, of which 17 are spare, and the North Box has a frame of 72 levers, of which 13 are spare.

Fig. 4 will not only serve to illustrate the interior of the South Box and Fig. 5 that of the North Box, but also to show the locking frames. The actuating feature consists, not of the usual lever, but of a horizontal slide having a handle in the front of the table, as seen. These handles are, as is customary, coloured black when connected to points and red when connected to signals. In the front of the table, behind sliding glass doors, is the interlocking gear, which is constructed on the usual tappet principle. The position thus given to the interlocking gear allows for its ready inspection. In the slide is a slot which carries a roller, coupled to which is the tappet of the interlocking gear. The first portion of the slot is cut diagonally. Hence the initial movement of the slide gives an upward movement to the tappet, so that the preliminary moving of the slide by the signalman causes the conflicting points and signals to be interlocked. Should any conflicting point or signal lever be in the reversed position the signalman could not move the lever, as its tappet would be locked and the roller could not travel to allow the lever to be pulled. When the initial inclined portion of the slot has been passed the roller travels along a horizontal length, so that the mid-way movement of the slide has no effect upon the interlocking, but as the roller reaches the end of the slot there is another diagonal cut which causes the last stroke of the slide to give a further movement to the tappet. That movement releases those levers which are locked until that lever has been pulled. It will thus be seen that conflicting levers are locked as soon as the lever movement begins, but the levers to be released are not free until the lever concerned is fully over.

An exceptional feature about this type of locking frame is the automatic completion of the stroke of the lever. In all power interlocking there is what is known as the "return indication." The lever working a set of points cannot be fully moved—either to the normal or to the reversed position—at one stroke. After having been moved a certain distance a check lock stops further progress. But the movement has, as we have seen, been sufficient to actuate the conflicting interlocking gear; it is sufficient, furthermore, to complete the circuit for power to be supplied to move the points from the existing to their new position. When that is done a return current comes from the points to the locking frame and takes out the check lock and allows the stroke of the lever to be completed. Put another way, unless the points have responded to the initial movement of the lever the stroke cannot be completed. Thus, in that event, the signalman knows that something is wrong. In the present frame these conditions are provided for, but the arrangement goes further. The "return indication" is furnished with a solenoid-operated plunger and roller acting in a second slot in the lever slide. When the current returns from the points the roller so acts on the slot that it automatically completes the stroke of the lever. The signalman, therefore, has not to stand and wait for the return indication so that he may finish the work. That is done whether the points are being moved from normal to reverse or *vice versâ*. For signals a return indication is not given when a signal lever is pulled, as no harm can result from a signal having failed to go to the "clear" position. The main essential in a signal is that it shall go to "danger" when the lever is put to normal. The return indication for a signal, therefore, is made when it is being restored, and the stroke is then automatically completed after the signal has gone to "danger." If the signal has not responded the lever cannot be put fully to normal; the signalman is thus advised that something is wrong, and since the interlocking is held the road cannot be changed.

The connections at the points vary according to whether they are facing or trailing points, or, to speak more correctly, whether or not they are provided with a facing point lock. Fig. 2 shows two sets of points so provided, whilst Fig. 3 is a trailing point that has no lock. The most pronounced difference between the two is that the trailing point—Fig. 3—has no equipment in the "four-foot," no shaft operated plunger, and no stretcher bar. There are, it will be seen in Fig. 2, three rods that couple the switches together. The front stretcher rod is that nearest the toe of the switches and that passes through the lock mechanism in the "four-foot." It has slots in it through which the plunger in the lock works. Normally, when the points are set for either direction, *i.e.*, when the lever is fully in its normal or its reversed position, the stretcher rod is held by the plunger; in other words, the points are locked at all times except when they are being moved.

Whether for facing or trailing the point mechanism is fixed outside, *i.e.*, in the "six-foot." The motor is carried in the cylindrical extension of the mechanism case. Inside the latter is a train of wheels connected to the motor, and a cam motion. The initial movement, in the case of facing points, when the motor is energised, is to draw in the rod seen in the foreground in Fig. 2, so turning the shaft, and slightly to push in the plunger, so unlocking the stretcher rod. The cam motion then moves over the switches, and when that is done, a further movement is given to the rod in the foreground and the shaft, and the plunger and the stretcher rod are then locked in their new position. From the toe of each switch runs a rod to the detector box, whereby it is guaranteed that each switch is in its proper position. Then on the plunger are other contacts which, in turn, guarantee that the points are locked. In Fig. 3 the two switches have to be "detected," and that is done by the rods which run from the toe of each switch to the detector box, which, in that case, is, with the point mechanism, fixed outside. All this detection is provided in order to prevent the corresponding signals being put to "clear" unless both switches are in position and locked.

The manner of giving the return indication is novel. After the motor has done its work and unlocked, moved and again locked the points, the remaining momentum causes the motor to generate a current which is sent to the lever which actuates the "return indication" and automatically completes the stroke of the lever.

It may be noticed that there are no locking bars coupled to the plungers of facing points. That is because lengths of track circuit are provided at the points and hold the point lever should any vehicle be on or near the switches. This arrangement gives full fouling protection in the rear and in advance of the points, which is much more than a locking bar could cover.

The signals, except dwarf signals, are operated by mechanism, either fixed at the base of the posts, or on the side of bracket signals, or in some cases on the arm itself. The return indication is given for one direction only, *i.e.*, when the lever is placed in the normal position. After the signal has gone to the "on" position by gravity the over-run of the motor develops a dynamic indication current, which actuates the return indication and completes the stroke of the lever and ensures that the signal has responded. Dwarf signals are actuated by solenoids and the return indication is battery-operated.

Route indicators are provided for six signals at the South Box and one at the North. These route indicators not only make signals less confusing to drivers but economise in arms and lamps. The provision of the seven route indicators at Cambridge has saved thirty-one arms and lamps. Two indicators provide for any one of six indications, one provides for five, two provide for four and two for three. Either letters or numerals may be shown.

Although one signal arm may be employed for trains entering on to any one of two or more roads, each such road has its own lever in the locking frame. Thus, at the South Box the signal outside the up reception road is provided with an indicator for six directions, and is actuated by any one of levers Nos. 97 to 102. By the use of what is known as selection one lever alone would have sufficed, but that would have necessitated additional electrical circuits for

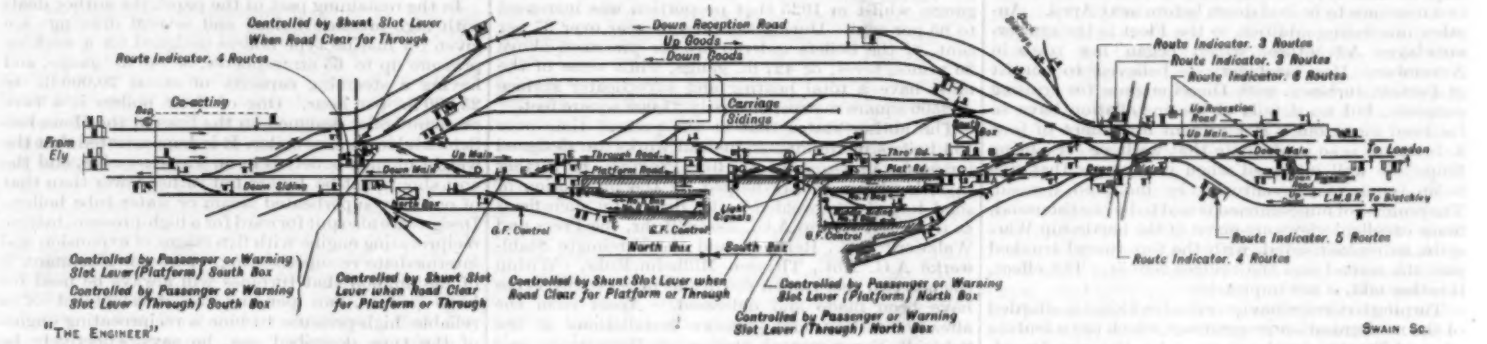

Controlled by Shunt Slot Lever When Road Clear for Through
Route Indicator. 4 Routes
Down Reception Road
Up Goods
Down Goods
Carriage Sidings
Co-acting
From Ely
Up Main
Down Main
Down Siding
Through Road
Platform Road
Down Reception Road
Up Main
Down Main
To London
To Bletchley
Route Indicator. 3 Routes
Route Indicator. 3 Routes
Route Indicator. 6 Routes
Route Indicator. 5 Routes
Route Indicator. 4 Routes
North Box
South Box
G.F. Control
Controlled by Passenger or Warning Slot Lever (Platform) South Box
Controlled by Passenger or Warning Slot Lever (Through) South Box
Controlled by Shunt Slot Lever when Road Clear for Platform or Through
Controlled by Shunt Slot Lever when Road Clear for Platform or Through
Controlled by Passenger or Warning Slot Lever (Platform) North Box
Controlled by Passenger or Warning Slot Lever (Through) North Box
"THE ENGINEER"
SWAIN Sc.

FIG. 1—PLAN OF CAMBRIDGE STATION

FIG. 2—EQUIPMENT AT FACING POINTS

FIG. 3—EQUIPMENT AT TRAILING POINTS

POWER SIGNAL BOXES AT CAMBRIDGE RAILWAY STATION

THE BRITISH POWER RAILWAY SIGNAL COMPANY, LTD., LONDON, ENGINEERS

FIG. 4—INTERIOR OF SOUTH BOX

FIG. 5—INTERIOR OF NORTH BOX

selection and would have involved complicated interlocking. Moreover, the use of definite levers ensures that the roads are "set" for the direction intended by the signalman.

It will be noticed from the diagram that there are three light signals on each side of the scissors crossover. They are for the platform road and are suspended under the roof in order to keep them from being confused with the through-line signals. The latter are carried on brackets and project well out over the platform line.

At Cambridge there is a considerable amount of working in either direction, and the South Box is therefore given two levers which control signal H at the North Box when it is required for the through line, and two levers to control it for the platform line. One lever in each instance is controlled by a track circuit extending through the station, and allows an unqualified "clear" signal to be given, whilst the other lever is controlled by a track circuit up to the home signals protecting the scissors crossing. An interesting feature about the latter control is that, although the signalman may move his lever from the normal position, the signal will not "clear" until the train enters upon a track circuit close to the signal. That precaution not only ensures that the speed of the train has been reduced, but meets the important rule, No. 40, which says that under such conditions a signal must not be put to "clear" until the train is nearly at a stand. A similar arrangement is in force at the South Box on the down main and down branch home signals.

Track circuiting is fully employed. There are forty-eight circuits with an aggregate length of four miles. One service to which they are devoted is the operation of indicators in the two signal boxes—see Fig. 5—whereon the occupancy of a track circuit section is indicated by the appearance of a red bull's eye on the corresponding section of the diagram. The disappearance of the red bull's eye signifies that the train has passed off the track circuit and that the section is again unoccupied.

Power is obtained from accumulators, supplied by the D.P. Battery Company, of Bakewell, in two lots of sixty-four cells each, or 128 in all. They are charged by a generator driven by an alternating-current motor, 440 volts. One half of the battery cells supplies power, at a pressure of 110 volts at the signal box, for point and signal operation, and the other half is split up into four sets, of sixteen cells each, for supplying current for lever locks, track circuits, detection, &c.

The signalling work described has been carried out by the British Power Railway Signal Company, Ltd., of Caxton House, Westminster, under the supervision of Mr. A. F. Bound, the signal engineer of the southern area, London and North-Eastern Railway. The photographs from which our illustrations have been prepared were supplied by the first named. To both parties, and also to Mr. C. J. Brown, the chief engineer for the southern area, London and North-Eastern Railway, we tender our thanks for an opportunity to describe what is among the most interesting pieces of signalling work that have been carried out in this country during the last few years.

THE MID-EUROPEAN WATERWAY.

THE importance of providing an uninterrupted waterway across Europe by connecting up the Rhine with the Danube is so obvious, that projects were conceived at an early date for effecting their junction, and a canal, quite insufficient for modern requirements, was begun in 1846. It was only forty years later that the scheme began to take definite shape by the deepening of the Main as far as Frankfort, and subsequently to Offenbach. The canalisation was then continued to Aschaffenburg, so that the Main can now be navigated by boats 85 m. long with a draught of 2·30 m. and carrying 1500 tons. In 1921 a company was formed under the title of Rhine-Main-Danube with a view of carrying out a complete programme, which provided for the construction of a canal from Aschaffenburg to Bamburg and thence to the Danube at Kelheim. The Danube itself was to be regularised the whole of its length for the passage of boats 72 m. long, 10 m. wide, and drawing 2·30 m. of water. The financial conditions at that time rendered it quite impossible to raise the capital of 900 million gold marks required for carrying out the scheme. It was then decided to continue the work progressively, and the great barrage of Viereth was constructed, with a lateral canal 300 m. long and 3·50 m. deep, followed by a lock of the same length. The barrage provides a head of 6 m. for the driving of three turbines coupled to alternators running at 75 revolutions per minute. They develop normally 2650 horse-power, and can provide a maximum of 4400 horse-power. The plant was put into service last year, and has been supplying an average of 18 million k.W. hours per annum to the Grosskraftwerk Franken. On the Danube the barrage at Kachlet, near Passau, was started upon in 1922. It raises the water level between Vilshofen and Passau, where the river had a dangerous rocky bottom and swift rapids, and the depth will now permit of the navigation of boats of sufficient tonnage. A power plant is being installed to utilise a head of 7 m., and will provide normally 7450 horse-power. The turbines will be coupled direct to alternators of 8500 kilowatts, and will supply current at 6300 volts. On the Main the work of deepening and regulating the river is being continued, and between Aschaffenburg and Wurzburg it is proposed to construct thirteen barrages which will divide the difference of level of 56 m. into falls of from 3·50 m. to 4·50 m., and will produce a total of 48,000 horse-power a year. By continuing these works on the Main and the Danube the two rivers will be eventually connected up, and will provide an uninterrupted waterway across the Continent, and the system will be completed to Marseilles by the junction of the Rhone with the Rhine.

SIXTY YEARS AGO.

IT is wholly wrong to suppose that the evil effects of trade unionism are of modern growth. Sixty years ago, in our issue of December 7th, 1866, we recorded that the repeated strikes which were occurring, first among the bricklayers, then among the shipbuilders, next among the puddlers, then among the miners, were doing incalculable and probably permanent injury to our industrial position. At that time, so we find it recorded, there was always an important strike in progress. Strikes, we argued, resulted in an increase in the cost of labour and materials, and to their frequent occurrence in this country we ascribed the fact that labour and materials were much more expensive in Britain than on the Continent. Our position was made worse because in those days, even without strikes, we had not too many hands to do the work. The consequence, which, we said, was beginning to be felt and which we prophesied would be more heavily felt in a short time, was that we could no longer produce goods or materials in this country at a profit. Those who could do so, we stated, were importing raw material from abroad. In this connection we recorded that we had recently seen in the yard of a London engineer channel bars of excellent quality which he had obtained from Belgium at a clear saving of £2 10s. per ton as compared with the cost of English bars of the same quality. Others, finding the use of foreign materials insufficient to enable them to meet competition from abroad, were importing the finished article or machine, made, say, in France under English inspection, and were putting their names on it and selling it "with all the prestige of that bright English reputation which still clings to us." Still others were going farther and establishing their own works in France, Belgium, Austria or Prussia rather than in their native land. We ended by recording that among the workers themselves the conviction was spreading that trade unions outside their legitimate objects possessed the power to do great harm to the well-being of the nation. We instanced the growth of this feeling by quoting a report of a meeting of working colliers that had recently been held at Sheffield. The meeting had been organised because an attempt was being made to introduce the union system at the Speedwell Colliery. One speaker urged that trade unions caused misery, inflicted injustice and cruelty and excited evil passions. To the activities of trade unionists another speaker ascribed the deserted houses and the ragged and hungry children of the Yorkshire industrial areas. Others spoke of the unions as instruments of evil and as responsible for degradation, misery and ruin. It was resolved to form a non-unionist society, and there and then ninety-six names were enrolled. The meeting closed with the singing of the Doxology. The events of the present year of grace do not encourage us to believe that the facts fully realised by those Sheffield miners of sixty years ago have even yet been properly appreciated by trade unionists in general. Hope, however, remains with us, for at this moment in Nottinghamshire, North Derbyshire, South Wales and Northumberland many miners, disgusted, as were their brethren of sixty years ago, with the aims and acts of their leaders, are endeavouring, apparently with the assurance of success, to break away from their national organisation with its largely political orientation, and to establish rational forms of local unions having purely industrial objects.

A SAND DREDGER FOR THE GREAT LAKES.

AN active business on the Great Lakes is the dredging of sand for use in filling "made land" and for building materials, asphalt paving and other purposes. One of the hopper dredgers used in this work in the neighbourhood of Chicago is a converted ocean steamer, 265ft. long, 43½ft. beam, and 20ft. loaded draught, with triple-expansion engine placed amidships, so that the vessel rides on an even keel whether loaded or empty. Its main centrifugal pumps can take a cargo of 2200 cubic yards in 1½ hours, and can deliver this ashore—from the hoppers—through 1500ft. of pipe line and to an elevation of 35ft. in two hours. The outlet of the pump can be rotated to direct the discharge at any angle, and the wearing parts are in sections to facilitate renewals. The suction and discharge openings are 20in. in diameter, with 18in. pipe connections. The pump runs at about 300 revolutions. In dredging, the 18in. suction lines are handled by tackle from winches. Two triple-expansion engines of 400 horse-power drive the pumps. In discharging, the hoppers are flooded by means of a high-pressure steam turbine pump. Longitudinal troughs receive the dredged material and are fitted with screens and gates, so that the load can be distributed and varied to keep the vessel in trim. The vessel carries a crew of twenty-seven men, and has a loaded speed of 14 knots. A sister ship has been fitted up in the same way, but with Diesel-electric engines.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THE COMMERCIAL LIMIT OF STEAM PRESSURE.

SIR,—With the main generalisations of the leader in your issue of November 26th I am in general harmony, but certain of its statements of the contents of my paper require in part correction and in part to be disclaimed.

A selection of particular statements may suffice to illustrate the character of the misapprehension underlying your leader. Take the following :—

(I.) You say :—"Indeed the highest pressure recommended in the paper for *any* conditions is only 400 lb. per square inch, and this for a station with low capital charges and the unattainably good load factor of 100 per cent." May I observe ?

(*a*) On the contrary, it should be obvious from my paper that under any conditions the pressure for maximum economy may be above 2000 lb. per square inch. The condition necessary for this is that the cost of plant per kilowatt installed for 2000 lb. per square inch must be practically the same as that for 200 lb. per square inch.

(*b*) The pressure for maximum economy given in the paper for the particular condition stated is not 400 lb. per square inch at the turbine stop valve, but 606 lb. per square inch at the turbine stop valve, corresponding to 640 lb. per square inch, say, at the boiler. The particular conditions being coal at 15s. per ton of 11,500 B.Th.U. calorific value, capital charge at 12 per cent., load factor 100 per cent., and for certain increases in cost of plant with pressure given in the paper. These increases are in my experience rather below the average ruling in this country now and for the past few years.

(*c*) It is directly deducible from the data given in the paper and by the methods explained in it that the pressure for maximum economy if the coal price was double and other conditions as in (*b*) above, would be 795 lb. per square inch.

(*d*) Alternatively, it is directly deducible that if plant can be purchased at one-half the rate given in the paper for increase in purchase price with pressure, the pressure for maximum economy is again 795 lb. per square inch, other conditions remaining as in (*b*).

It was precisely because the basic conditions are subject to such variation that the paper was presented in such a way that the effect of any variation in the basis could be readily deduced.

(II.) The statement immediately preceding the one just criticised reads as follows :—

"As Mr. Guy's table of commercially economical pressures ranges from 227 lb. per square inch to a maximum of 355 lb. per square inch for a station with a load factor of 50 per cent., &c."

This is not a correct statement. The table of commercially economical pressures is Table No. 4 and ranges from 366 lb. to 459 lb. per square inch for a load factor of 50 per cent. and other conditions as specifically stated in the paper. Again, the effect of variations in these conditions can be readily obtained from the curves given and the methods outlined in my paper.

(III.) Consider the statement reading as follows :—

"It is rather the reasoned contention of a responsible engineer that further advance can only lead to a profitless—though no doubt interesting—wilderness."

The natural and apparently intentional implication of this statement coupled with its context is that the point beyond which further advance would be profitless would, in my opinion, be 350 lb. per square inch.

A cursory glance at figure 16 alone should show that even with 50 per cent. load factor and 12 per cent. total charges the adoption of 830 lb. per square inch still returns 5 per cent. net interest on the additional capital invested, after having covered 5 per cent. for depreciation and 2 per cent. maintenance on the additional price. On the other hand, Fig. 16 also shows that it is more profitable to adopt any other pressure between 200 lb. per square inch and 830 lb. per square inch.

(IV.) The concluding statement is :—"These considerations tend to weaken our faith in prophecies even when supported by calculations, and we look to see before very long steam pressures in common use which are very considerably greater than Mr. Guy would seem to think justified."

After moralising on the follies of prophecies this particular example is unfortunate, based as it is on a misapprehension for which I must really disclaim responsibility.

Taken in conjunction with the preceding "final thought" and coupled with the statement to which exception is taken under (III.), it can convey only the impression that in my paper I prophesied that pressures above 350 lb. per square inch will never be justified.

How very misleading and unwarranted such statements are can best be emphasised by comparison with the penultimate paragraph in the paper itself—see THE ENGINEER, November 19th. This reads :—

"It is but natural to suppose that in the ordinary process of engineering development the ratio of increased cost of the plant for generating and utilising increased pressure will tend to decrease. On the other hand, average machine load factors and perhaps the price of fuel will tend to increase. Such change will, of course, affect the value of the economic pressure, which can at any time be readily ascertained from the diagrams included in the paper."

Thus the only prophecy I permitted myself was that as time goes on the factors which control the economic pressure will change in such a way as to raise continuously the economic pressure.

May I emphasise that the meat is to be found in the curves themselves ? The letterpress argues their basis and explains their use, and the paper will not be understood unless the figures are studied.

My conclusion in this matter is to be found in the final figure of my paper. It can be read directly, for results apply to the conditions clearly stipulated, conditions which, in my opinion, fairly represent the average prevailing in the country up to the present time.

For other conditions the corresponding values are obtained—as explained—by making use of the following relations :—

If r = rate of capital charge chosen,
l = load factor chosen,
k = increase in purchase price above 200 lb. per square inch with pressure,
c = purchase price of fuel reduced to a calorific value of 11,500 B.T.U. per pound,

then either the pressure corresponding to maximum economic gain or that corresponding to one-half per cent. less gain than the maximum can be obtained by using the fact that both are proportional to $\frac{r}{l} \times \frac{k}{c}$.

As a further illustration of the use of this figure and to eliminate the possibility of any further misunderstanding, may I point out that the curves and methods presented in my paper enables the permissible increase in purchase price of plant to be obtained for any load factor, cost of fuel and capital charges necessary to make any particular pressure either the pressure for maximum economy or a pressure which makes a saving of ½ per cent. less than the maximum. Examples of these are as follows :

(*a*) For 800 lb. per square inch to be the pressure for maximum economy with coal at 15s. per ton and 60 per cent. load factor with 12 per cent. charges the plant must be purchasable at not more than £0·462 per kilowatt installed above the price at which plant for 200 lb. can be obtained. This ratio of increase of purchase price with pressure is practically 30 per cent. of the prices given in the paper.

(*b*) If the price of coal is 20s. per ton all other conditions, remaining as in (*a*), the permissible increase in price is £0·616 per kilowatt, or practically 40 per cent. of the basis adopted.

(*c*) If the rate of capital charges is changed to 18 per cent., other conditions as (*a*), the permissible increase in price is £0·308 per kilowatt. On the other hand, if in addition the price of coal is changed to 20s. per ton, the permissible increase in price is £0·411 per kilowatt.

In order to make 800 lb. per square inch the pressure, which gives one ½ per cent. less gain than the maximum possible gain, the permissible increase in purchase price with pressure for cases (*a*), (*b*) and (*c*) are approximately 40 per cent. of those stated in those paragraphs themselves.

Further, if there is no increase in purchase price of plant with pressure, the pressure for maximum economy for all rates if capital charge and all load factors may be above 2000 lb. per square inch.

Finally, readers of your leader and my paper may reflect that the decisions made in this matter by power plant engineers in this country in the past few years may not result from the uninstructed conservatism and incompetence you imply, but may have had a sound economic justification.

December 2nd. H. L. GUY.

THE ELECTRICITY BILL.

SIR,—With others I myself am very doubtful whether this Bill will be of any more benefit to the public at large than the amalgamation of the railways has proved to be, and I am afraid I have become cynical enough to doubt whether it is intended to be. Your correspondent, in your issue of the 3rd inst., is, I think, rather hard on the inhabitants of this island. There are still a few persons quite willing to work both with hand and brain, but they are not willing to work when the proceeds are collared by the Inland Revenue and squandered in various wild cat enterprises in Asia and elsewhere. If the fruits of a man's labour is no benefit to himself no one but a fool would expect him to work.

No doubt a much larger proportion of the people than formerly have learned to live on public charity (?), but this is only human nature, especially to be expected when not buttressed by the results of a sound education. When the educated (?) union members spend nearly all their time fighting for higher pay and less work, can you blame the product of such education factories, which afterwards makes, say, the Boilermakers' Union for following the same line ? I am afraid, Sir, the trouble lies deeper and is the result of the loss of a manufacture or art that is certainly one of "national importance," and which art has been lost—it is to be hoped only temporarily—for some years. Before "the war," in fact.

This lost "art" is the production of "statesmen" as distinguished from mere "politicians" masquerading as the former. If you go to an ordinary retail shop for some small brass article and forget to take a magnet with you, it is most probable that you will be given an iron article brassed over to look like brass. I am afraid this country is possessed of "brassed-over" governors bought as solid brass, and the purchasers are likely to be rather disgusted when a short time in the present-day corrosive atmosphere covers them with red rust instead of verdigris. It is as well perhaps to add, since THE ENGINEER is not a political journal—thank goodness—that I am not referring to the present or any particular lot. There is little to distinguish between any of them. None resist corrosion and the only choice is the colour, black, red or green. GEO. T. PARDOE.

Angmering, December 6th.

THE FLETTNER RUDDER.

SIR,—Your correspondent, Mr. Stanley P. Christie, would do well to clear his mind of otter boards before considering the theoretical aspect of the Flettner rudder, for the cases are not parallel.

The modern Flettner rudder has an "aspect ratio" of about 1½. A plane of this shape moving through a fluid develops its maximum normal pressure when inclined about 26 deg. to the direction of motion—see paper entitled "The Steering of Ships," by Parker and Brown, Inst. Mar. Eng., 1926. It is an ascertainable fact that Flettner rudders can reach a much larger angle than this, and the angle normally attained is 38 deg., well beyond the "critical angle."

The fact that vessels of normal design, such as the motor ship Sorrento—2700 tons deadweight—turn as easily and on as small a radius as similar vessels fitted with ordinary rudders, is now beyond doubt, as numerous trials have demonstrated. Mr. Christie may read the reports of such trials in the paper on the Flettner rudder read before the Inst. Mar. Engrs. in January, 1926.

Mr. Christie's main point of attack seems to be against the power absorbed by the rudder from the slip stream. Let us consider therefore what power is actually taken from the slip stream. In the first place, it must be understood that all rudders, in deflecting the flow of water in the slip stream, absorb power from the main engines. It is, in fact, from that source that they derive their ability to exert a turning moment on the ship. The difference between a Flettner rudder and an ordinary rudder of the same area and shape is that the former has in addition a fin at its after edge. The amount of power absorbed by that fin is the difference between the power absorbed by a Flettner rudder and by an ordinary rudder.

In the case of the m.s. Sorrento, the area of the secondary rudder was 10·9 square feet, and its aspect ratio was 7. By the nature of the controlling mechanism it would be impossible for the fin to be placed at more than 45 deg., say, to the direction of motion. In the neighbourhood of this angle, the normal pressure on the fin would be about 203 lb. at 11 knots, the speed of the ship. The fore and aft component of this force is 203 × sin 45 deg. = 143 lb. The effective horse-power absorbed

$$= \frac{143 \times 18 \cdot 6}{550} \text{ (f.p.s.)} = 4 \cdot 8.$$

Using a propulsive coefficient of ·5, the brake horse-power absorbed from the engines would be about 9·6, i.e., about ·9 of 1 per cent. of the total brake horse-power (1050). There is, too, the negligible quantity of power absorbed in actually moving the rudder from midship to the desired angle of helm.

Contrast the absorption of less than 1 per cent. of the power of the main engines with the absorption of anything between 40 and 60 per cent. of that power which takes place during turning, due to the vessel's inevitably oblique motion through the water, and it will be apparent how unimportant in any case is the actual power used in producing that normal pressure on the rudder which is the source of turning power—see "Turning Circles," by Hoovgaard, I.N.A., 1912; "Steering Qualities of Yashima," by Watts, I.N.A., 1898; "Turning Power of Screw Ships," by Colomb, I.N.A., 1886.

Finally, it would appear that Mr. Christie is labouring under a misapprehension when he speaks of a "well-balanced" rudder, for "well-balanced" is only a comparative term, and means that the rudder is a good compromise of balance for ahead and astern motion. It is not possible to balance a rudder for more than one helm angle, because the centre of pressure changes with every fresh angle—see "The Design of Balanced Rudders of the Spade Type," by Maurice Denny, I.N.A., 1921. The Flettner rudder, on the other hand, is re-balanced by means of the secondary rudder for every fresh helm angle desired.

London, S.W. 1, December 8th. F. A. BEST.

BRITISH ENGINEERING.

SIR,—As an English engineer, resident abroad, may I be permitted a little of your space to point out one of the causes which is doing enormous damage to British engineering prestige and thereby inflicting grave injury upon the export trade of the country ? I refer to the growing habit amongst British manufacturers of contenting themselves with constructing machinery of foreign design under licence instead of originating designs of their own. It is within my own knowledge that British tenders have been turned down, practically without consideration, on the grounds that it would be obviously safer to buy the machinery in question from the continental firm who originated it than from the English firm who were manufacturing it under licence. This attitude on the part of purchasers is a perfectly natural and logical one, and foreign manufacturers cannot be blamed for encouraging it. The British licensees deliberately choose to follow rather than lead, and as licensed copyists they have to be content with such few orders as they can secure on a price basis. Most of the articles for which the British manufacturer puts himself behind the foreigner are within the power of any decent draughtsman to design, and such patents as are held in respect of them are in general quite worthless. The designs themselves are often of the most mediocre description and need much expenditure of time and money to develop into something really satisfactory. I can call to mind at the moment no less than six old-established British firms who have not even been able to produce so simple a thing as a steam jet air pump for themselves, and the number who cannot build a large oil engine or an impulse turbine except under foreign tutelage is scandalously large. While this sort of thing goes on it is hopeless to expect much in the way of export trade, for hyphenated engineering is at the same time a confession of incompetence and an advertisement for the foreigner.

December 4th. ENGLISHMAN ABROAD.

UNEMPLOYMENT: THE REMEDY.

SIR,—The notice of Mr. Mullins' book, "Unemployment: The Gateway to a New Life," in your issue of November 26th, is of great interest to all who see in a return to the land the one satisfactory remedy for the ills of society. It is also of very special interest to those who are now actually engaged in starting a concrete scheme for carrying out its ideas. The National Homecroft Association was started in May this year for the purpose of enabling town workers to acquire sufficient land on which to grow all the food they themselves and their families consumed. The ideas of the promoters of the association correspond in a remarkable manner with those expressed in your article, though the really remarkable thing is that they have not occurred to more.

As you say, the weak spot—I should rather say, the doubt—is whether the working classes will take advantage of the opportunities offered them. But this is really a reason for urgency. The longer the people are kept from the land, the more likely is the natural instinct for outdoor agricultural work to become atrophied. There is therefore every reason to push forward at once a scheme like that of the National Homecroft Association. If we allow doubts of its success to delay us and continue to drift on, the evils of unemployment, physical deterioration, social unrest, national starvation, will assume such dimensions that one fears to think what the end will be.

A full account of the Homecroft idea will be found in Professor J. W. Scott's booklet, "Unemployment: A Suggested Policy" (A. and C. Black, 1s.), and any information about details can be obtained by writing to the secretary of the Association, 38, Charles-street, Cardiff.

A beginning has actually been made at Cheltenham, where 10 acres have been purchased and prepared for twenty-five tenants who are ready to take possession as soon as the houses are ready.

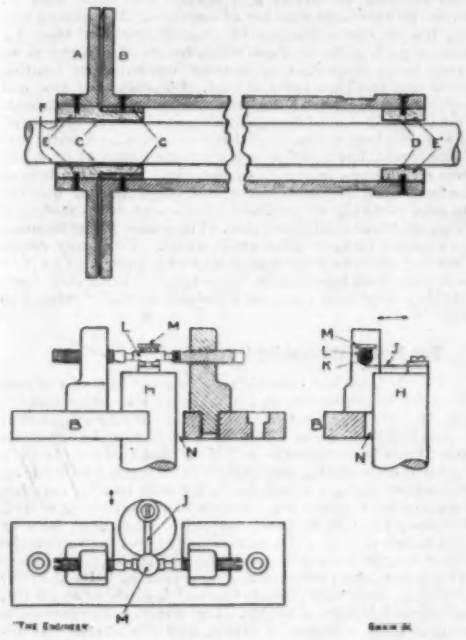
FRANCIS HUGHESDON.

41, Murray-road, Wimbledon, December 6th.

THE *Muenchener Neueste Nachrichten* reports that the Luftschiffbau Zeppelin Company of Friedrichshafen has now decided on the details of the new airship for the Europe–South America service. The ship will hold 105,000 cubic metres of gas, will be 235 m. long, and its greatest diameter will be 30·5 m. A special feature of the vessel will be that for the first time the engines will run on gas and not on petrol. The machinery will consist of six motors. The passengers' quarters will, also, for the first time, include individual sleeping cabins and a general saloon, there being twenty-four cabins for the night service. By day twenty-eight passengers will be accommodated. The number of passengers arranged for is small, as the ship will only be used for long journeys.

A New Design of Recording Torsionmeter.

THE following description of the Parker-Jackman recording torsionmeter is taken from a paper presented on Wednesday of this week by Messrs. R. G. Parker and D. N. Jackman before the Institution of Chemical Engineers. We had an opportunity recently of inspecting this dynamometer at the works of Adam Hilger, Ltd., London, to whom its manufacture was entrusted. In its present stage of development it is a small-sized instrument intended for



FIGS. 1 AND 2

the measurement of small powers, and was evolved, we understand, for the express purpose of studying the power absorbed in the driving of washing and other laundry machinery. We gather, however, that its application in larger sizes and for general purposes is under consideration. The dynamometer is of the transmission type, and, like the Denny-Johnson, Föttinger, Hopkinson-Thring, Amsler, Moullin and other torsionmeters, does not itself convey power. It makes use of a moving photographic film, on which the power transmitted is recorded in direct terms.

Consider two points, in line with the axis, upon the surface of a piece of 2in. steel shaft, 18in. long. When this shaft is transmitting 1 horse-power at 170 revolutions per minute, it will be twisted through approximately 0·02 deg. for every 18in. of its length, and the points will therefore be out of line by about 0·0004in.

In order to measure the twist over this length of shaft, it is convenient to cause it to take place between two arms A and B—Fig. 1—which are close to one another. This is done by supporting the arm A by a clamp fixed to the shaft at C, while the arm B is carried on a long rigid sleeve fixed to the shaft at D. The distance C D between the two clamps is the standard test length of shaft. The arrangement rotates as a whole with the shaft, the twist appearing as a relative movement between the two arms A and B. The first magnification is obtained by taking points upon A and B as far from the axis as possible. By this means the actual displacement of two parts upon the opposing arms may be increased to 0·002in. per horse-power at a radius of approximately 5in.

The method employed in the Parker-Jackman torsionmeter to obtain the requisite further magnification is shown diagrammatically in Fig. 2. H is a very stiff pin attached to the arm A—not shown—and projecting through an aperture N in the arm B. H carries a small knife-edged spring J, which engages with a groove at K in a spindle L. M is a mirror. It will be seen that if the shaft is twisted, causing a minute movement of A relatively to B—Fig. 1—then there is the same minute movement of H relatively to B—Fig. 2—in the direction indicated by the double-ended arrow. Owing to this movement, J will rotate L, possibly through several degrees.

The general arrangement of the dynamometer is shown in Fig. 3. The instrument is not large, its overall dimensions when erected being 2ft. 6½in. long by 1ft. 3in. by 7¾in., which become when packed 2ft. 6in. by 1ft. 6in. by 8¼in. In order to save weight aluminium has been used extensively, and the total weight, with one set of steel bushes, is 66 lb., or 80 lb. complete with the wooden carrying case. The instrument shown was made for use upon shafts from 1in. to 3½in. in diameter—extreme limit, 3¾in.

The central bearing has been so designed that motion may be very free, but entirely without play—which tends to produce large oscillations of the mirror. This result has been attained by the use of four self-aligning ball bearings D—Fig. 3—the outer races of which roll upon the surface of the extension of the cast iron bush E, which is ground true. The adjustment of this bearing is effected by means of bolts acting in opposition to four set screws.

The three main portions have been separately balanced, and the bar F, balancing the light-tight box G, has been utilised to increase the stiffness of the central member. A point of the design is that the moving parts are so placed that they suffer the least possible deflection by centrifugal force.

Each bush is only in contact with very short lengths of the shaft—¼in. long—so that the clamping pressure upon these areas may be high, in order to hold the dynamometer very firmly in position. These narrow areas of contact also allow the length of shaft under test to be measured with sufficient accuracy. Thus the present instrument measures over a standard length of shaft of 17in. ± ¼in., and the standard length is therefore known with a maximum error of ± 0·7 per cent. The member carrying the arm A, which is of small dimensions in the direction of the axis, is provided with a bush having two of these projections, in order to prevent any tendency to rock. In order that the standard length of shaft may correspond to C D—Fig. 1—and not to F D or some indeterminate intermediate length, the ring C—Fig. 1—is made of slightly smaller radius than the ring F, and therefore grips the shaft tightly, while the other is merely in contact with it.

The whole mirror mount H—Fig. 3—can readily be withdrawn for the fitting of any one of a series of interchangeable spindles of varying diameter. The mirror and spindle are very lightly constructed in order to reduce any damping of the power oscillations. The mirror is also balanced, in order to reduce any centrifugal effects. The spindle is carried in jewels, and these parts are delicately made in order to obtain a very close fit without play.

The camera—Fig. 4—is mounted separately upon a member supported by two bushes J K—Fig. 3. This member also carries the source of light, the sliding contact for lighting the lamp, the brake, and the worm and the gears for driving the sensitised paper within the camera. When in use, the instrument must be erected in such a way that the camera is towards the driving end. Were it at the driven end, the power taken to drive the camera, moving the paper band, would be recorded, and it has been found that a considerable and varying error is thus introduced.

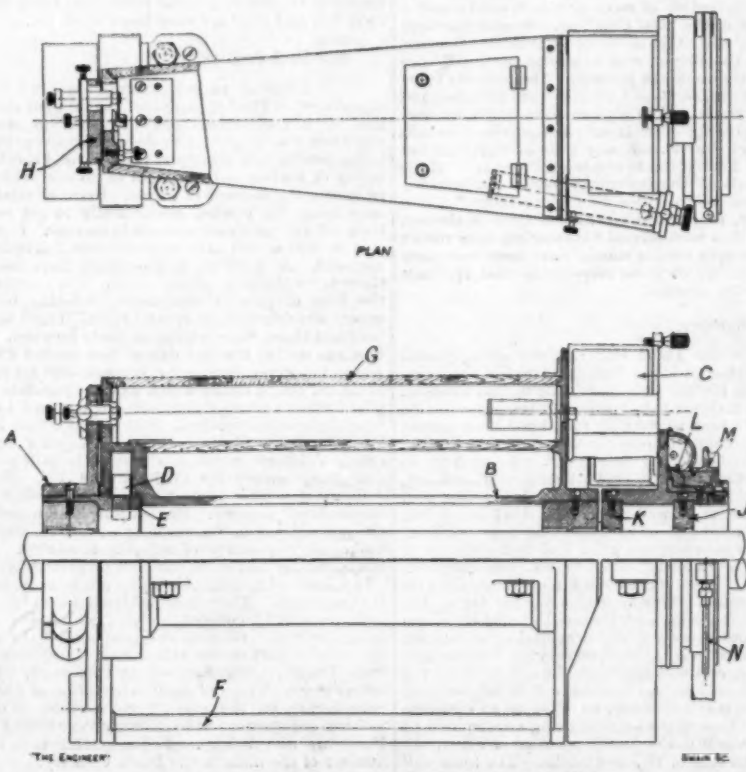


FIG. 3—THE PARKER-JACKMAN RECORDING TORSIONMETER

The speed of the sensitised paper is determined by a roller R—Fig. 4—whose speed is constant relatively to that of the shaft. The relative speed of this roller can be varied by changing the pinions provided, and it can be caused to rotate always in the same direction, whatever the direction of rotation of the shaft. The paper is drawn from the spool S, against the resistance of adjustable brakes, and after passing the slit it is taken up by the spool T. The pinion, which drives T, revolves faster than is necessary. A spring clutch allows slip in order that the paper may not be broken. By adjusting the brake screws and the clutch any desired tension may be maintained. These adjustments are necessary in order that the paper may travel through the system without any tendency to stick, buckle or move transversely. When the apparatus is revolving with the shaft on which it is mounted, the train of pinions moving the sensitised paper is set in motion by holding the worm L—Fig. 3—stationary by means of the brake band M and the Bowden cable N.

The speed of the band of paper being proportional to that of the shaft, it is clear that a given length of paper represents a fixed number of revolutions. In the examination of certain machines an allowance of 2in. to 4in. per 100 revolutions of the shaft was found convenient when the shaft was revolving at 300 revolutions per minute and the machine at a maximum speed of 30 revolutions per minute. Lengths of paper up to 10ft. can be accommodated

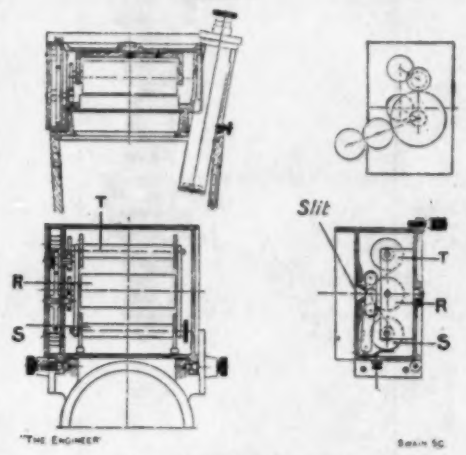


FIG. 4—DETAILS OF CAMERA

by the spools, giving a maximum run of 20 minutes—at 2in. per 100 revolutions and 300 revolutions per minute. The scale of time upon the record is 6in. to 12in. to one minute. The time is truly recorded if the speed of the shaft does not suffer sensible changes. This condition may or may not be fulfilled. Small or rapid fluctuations in power do not cause serious alterations in the speed, but the change between no load and full load may be important.

The distance between the axis of the shaft and the mirror needle is 5·3125in., and the mirror is 17·25in. distant from the sensitised paper. When the dynamometer was mounted upon a 2in. mild steel shaft rotating at 265 revolutions per minute, the displacement of the image upon the photographic record was found to be 1·15in. per horse-power, the mirror spindle being 0·032in. in radius. A spindle of radius 0·0815in. gave, under the same conditions, a displacement of 0·453in. per horse-power.

The results of tests showed that the observed deflection was proportional to the power, except for evidence of slightly low readings at extreme deflections. This was shown also by measurements made under static conditions, and is to be expected on theoretical grounds. The displacement of 1·15in. per horse-power corresponds to a value for C of 12,800,000 lb. per square inch, while the static measurements gave a value of 12,600,000 lb. per square inch. These values correspond to observations differing by 1·6 per cent., and may be regarded as in good agreement.

The apparatus can be loaded and unloaded in daylight. The shafting upon which it is mounted must, of course, be stopped for this purpose.

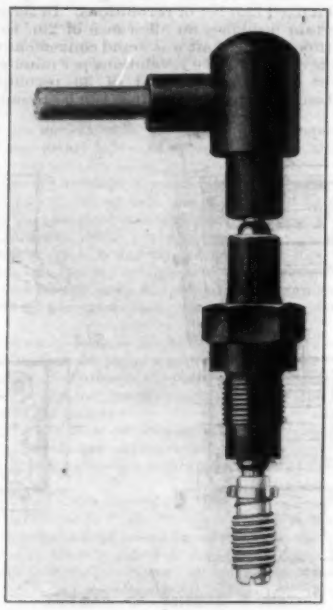
Although the instrument has been designed primarily to give continuous photographic records of power transmitted, it can be converted to give readings of the average power being transmitted. If, for example, the camera and slit are replaced by an optical system consisting of a lens and an optical wedge whose opacity varies uniformly from one end to the other, and the light passing through this system is allowed to fall upon a selenium cell, the conductivity of the cell will vary with the position of the reflected beam of light, and hence with the power being transmitted. It is clear that a milliammeter, operating in conjunction with the selenium cell in the usual way, can be graduated to read directly the mean horse-power being transmitted.

QUEEN'S ENGINEERING WORKS.—On Saturday last, December 4th, the Association of Past and Present Students of W. H. Allen, Sons and Co., Ltd., gave their fourteenth annual dinner at the Trocadero Restaurant, Mr. H. R. Howlett, who is the active secretary of the Association, occupying the chair. There was, as usual, an excellent attendance, and several eminent guests, including Vice-Admiral Sir Robert Dixon and Mr. R. W. L. Phillips, borough electrical engineer of Bedford and President of the Incorporated Municipal Electrical Association, were guests of the evening. Mr. Howlett made an admirable chairman, and in responding to the toast of "The Association," proposed by Mr. Richard Allen, announced that the Association had decided to establish a memorial to the late Mr. W. H. Allen, which would take the form of an annual prize for the students.

A New Type of Heating Plug.

In the process of starting up from cold an oil engine working with low or medium compression, it is usual to supply heat from an external source to the combustion chamber. Several methods may be used. A very usual plan is to warm up one of the walls of the combustion chamber by means of a blow lamp or, again, the flame of the lamp may be directed on to a special heating plug. Of late igniting cartridges have also been successfully employed. For convenience and speed, however, electrical heating has much in its favour. For one thing, the heating element can project right into the combustion space, which increases the speed with which an engine may be got under way. Although heating plugs have often been used in cases where a supply of current is available, they can now be supplied to work with comparatively small batteries.

With a view to meeting the demands for such a plug, the Rugby firm of Lodge Plugs, Ltd., has recently placed on the market the new type of heating plug which we show in the accompanying illustration. As will be clearly seen,



the heating element consists of a single wire spiral of moderately thick high-resistance alloy, which is wound in a groove cut on a steatite insulator. The makers claim that one advantage of this particular construction is that the wire is firmly supported over its whole length and it is not affected by rapid changes of temperature. When the current is switched on the heating element takes less than one minute, we are informed, to reach its maximum temperature of 1000 deg. Cent. The steatite support attains, too, a temperature of about 800 deg. Cent. It is further claimed that the heating plug offers a comparatively large incandescent surface for igniting the oil spray, and that for the small current consumed it has a large heating capacity. The plug we illustrate is designed to work with a 12-volt battery and it takes a current of about 13 ampères. The terminal, which is shown at the top of the plug, is of the "push-on" type and it is designed to act as a convenient form of switch. As the surface contact is ample for the current carried and the terminal is completely insulated there is little fear of accidental short circuits.

South African Engineering Notes.

Road Motor Services.

The general manager of the South African Railways has great belief in road transportation as a railway auxiliary, and expects to see very considerable developments in the service run by the Administration. He prophesies that the present mileage operated—some 2500—will in three years grow to equality with the railway mileage open, or close on five times the present figure. The latest service to be opened is in the Free State between Bloemfontein and Dealsville, and it is being operated by a Thornycroft 1½-ton truck with a Johannesburg-built body. The fore part of the body accommodates eight passengers, while the after part provides space for light goods and native passengers. The vehicle is mounted on 7in. pneumatic tires, operating at 100 lb. per square inch. The fare charged is 3d. per mile.

Rand Engineering Shops.

An outstanding feature of industrial Johannesburg is its importance as an engineering centre, which is, of course, due to the requirements of the Rand gold mines, among which it is situated. In Johannesburg there are over a hundred engineering firms and foundries. Most of them possess large workships, employ many men, and can produce almost anything of a mechanical character required in the Union of South Africa. Recently a local firm supplied between thirty and forty boilers and engines, for irrigation purposes, to the Administration in South-West Africa. Everything was manufactured at the works and gave the highest satisfaction. These boilers and engines are intended to drive windmill equipment on farms when the wind fails, as is the case for weeks on end in certain parts of this territory. At other times the machinery is adapted for other uses on the farms. Rhodesia is a very good customer of the Johannesburg engineering firms. Just a little while ago some well-drilling machines were urgently wanted. As time was too short to order from America, where the Rhodesian firm usually bought, a Rand firm was approached. Not only was the concern able to manufacture the machines at competitive prices, but the machines when completed had certain improvements which had been invented to suit the special conditions in Rhodesia. Most of the engineering firms specialise in one or two products, but the industry as a unit can undertake to turn out practically anything in Johannesburg. The mines, of course, play a great part. For example, about thirty small firms, employing perhaps five or six men each, find enough work to keep them busy by manufacturing spares for jackhammers on the mines. Some of the larger firms go in for the manufacture of mine skips, headgear sheaves, winding drums, and a host of other contrivances which are continually in demand on the mines.

A New Mine at Last.

The people of Johannesburg, and all along the Rand, have been much pleased at the official announcement that the Government of the Union of South Africa has accepted a tender of the Union Corporation, Ltd., for a lease of 2641 claims on the farm Geduld, adjoining the Geduld Proprietary Mines' property to the east. The Union Corporation controls the Geduld Proprietary Mines, Ltd., and has made arrangements with it whereby the Geduld Proprietary secures an interest in this area equal to that of the Union Corporation. Ltd., and is to give adequate facilities for opening up a large part of the lease area through its workings. No further details of the lease are obtainable at the moment, but it is believed that they will be found similar to those on which the Sub-Nigel obtained the right to work the Grootfontein area. The Union Corporation made an offer previously in 1922, but it was a provisional one, dependent on investigation, which was not allowed. The Mining Leases Board has since, however, admitted a similar principle in connection with the Sub-Nigel. In the case of that mine a period of four years is allowed the company to investigate by development; after that it rests entirely with the company to decide whether or not the development during the period warrant the sinking of additional plant and exploiting the area. Within the last few months the Government has leased or sold mining areas to several producing companies, including Meyer and Charlton, Sub-Nigel, Crown-Mines, and the New Kleinfontein Company, and now the Geduld Proprietary Mines is to have a 50 per cent. interest in the opening up of Geduld East. It is hoped that the starting of work on Geduld East will lead to the reopening of mines on the Far East Rand, which were closed down some years ago through exhaustion of funds. These mines belong to the Grootvlei Proprietary Mines, Welgedacht Exploration Company, and Daggafontein Mines. The main reef on Geduld lies at a depth of 2000ft. to 4000ft. The Geduld Proprietary Mines, Ltd., has obtained an average of just over 7 dwt. per ton, while the Modder East on the north has recovered 7·87 dwt. a ton.

Rails from Germany.

The Railway Board has sanctioned the placing of an order for £250,000 worth of rails with Germany, apparently in anticipation of an early rise in prices, owing to the operations of the Steel Combine. Quotations were invited by cable, and it is understood that the German price was below the British and American, and will save the Union some thousands of pounds. The rails are to be from 60 lb. to 80 lb., and will be sufficient to relay 150 miles of double track. It is also understood in connection with the splitting of rails on the electrified section of the Natal line, that almost any rails of equal calibre would have split if subjected to the same stresses. "Rails of one or two makes," the statement goes, "are involved and heavier types will be used to replace them." This may, it is stated, necessitate a different type of sleeper. With regard to this semi-official explanation it is rather unfortunate that derailments should have been necessary to bring to the notice of those responsible that the rails were unequal to the stresses.

Table Bay Harbour.

Work on the Table Bay Harbour development scheme is proceeding rapidly. The extension of the existing breakwater by 1500ft., though delayed by bad weather, has made substantial progress. About 200 concrete blocks weighing from 15 tons to over 30 tons have been placed in position. Reclamation from the sea of a great portion of the area required for the widening of the South Arm, so as to enable steamers to berth on both sides of it, and not, as at present, only on the side forming the interior wall of the existing docks, is well advanced; 1657 lineal feet of the quay wall have been constructed to the required level, and upon it mass concrete has been laid to a distance of 1315ft. Coping for a distance of 1126ft. has been set. Three hundred feet of a random block mole or breakwater have been constructed. This mole commences far to the east of the present docks, and runs out almost as a continuation of Adderley-street, the principal street of the city. It will proceed in a big sweep across the Bay towards the present docks, and will approach the extension of the South Arm of the docks. An opening will be left between the mole and the pier extension, to serve as an entrance to vessels using the new docks now being constructed to the east of the present docks, the South Arm of which will serve as the north side of the new docks. The mole will also shelter the new docks, especially from the violence of south-east winds. It is estimated that seven years will be required to complete the work. The extension of the South Arm—or new south pier—is being pushed on energetically with the aid of three Goliath cranes and a pile-driver. The new mole is being constructed mostly of 6-ton to 7-ton blocks of concrete, which are dumped in the sea by a crane. Parallel with the line which carries the crane is a miniature track carrying small trucks bearing rubble. The concrete blocks are first dropped at random to make a foundation, and the rubble is then filled in as required. The new floating dock to take small craft, 400-500 tons, has been assembled and launched, and has already accommodated some of the steam fish trawlers.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Market Activity.

There were decided signs of a renewal of activity at the weekly meeting of the Midland iron and steel trade in Birmingham to-day. There was a larger attendance than recently of buyers and sellers, and merchants reported an increased number of inquiries. Bargaining was possible in circumstances of greater freedom than for months past. The business done, however, was not at all large, being restricted to current needs. The limiting factor was the high price of coal. Consumers of iron and steel were anxious to obtain information as to the probable course of prices, and to some extent they were successful. The quotations given were high as compared with pre-strike levels, but opinion was expressed that they would form a fair basis on which to bargain. Large numbers of works in the Midlands have full order books, but the business can only be profitably dealt with when materials are available at moderate rates. The policy at the moment is to await further price concessions. Producers adopt a similar attitude with regard to fuel supplies. The New Year should see industry in full swing, but until then there is little prospect of the heavy industries really getting to work.

The New Staffordshire Iron Prices.

It is at last possible to give some idea of the new prices for Staffordshire finished iron. For some months past, though production has not been entirely suspended, no material has come on to the open market, and quotations would have been superfluous. Now that fuel supplies are available once again, production is increasing to such an extent that makers anticipate being able to offer supplies of bars in the near future. With a view to booking orders, therefore, they have fixed the price of marked bars at £14 10s. per ton, which is an increase of 10s. per ton on the price ruling at the outbreak of the coal strike. It is interesting just here to recall that at this time in 1913, the year before the war, Staffordshire marked bars stood at £8 10s. and unmarked bars at £6 10s. The intervening years have brought great changes in prices, and the alterations unfortunately have not been for the betterment of trade. Of course, fuel is not yet available at the same rates as in April last, and the recent increase in bar iron prices is only just sufficient to cover the additional costs of production. Crown bar prices have not yet been definitely fixed, but quotations on 'Change in Birmingham to-day ranged round £13 per ton, a figure which compares with £11 10s. ruling before the strike. Lancashire houses are competing for this trade, and a limited amount of iron of Crown quality has reached Birmingham from that district. The ironworks have plenty of orders, and are merely waiting the inevitable fall in coal values to resume full activity. Among the signs that new work may be looked for is the placing by the railways of orders for materials connected with rolling stock. The wagon works in the neighbourhood of Birmingham have well-filled order books on which they will be glad to resume operations when the requisite fuel, iron and steel are once more available.

The Steel Position.

There is as yet no great activity in the steel department. The big plants are still idle for the most part, and until fuel values settle themselves steel masters can hardly be expected to declare future prices. Coal is being bought as sparingly as possible, and it is the declared policy of leading industrialists to do everything they can to hasten the descent of prices. Users of steel have been canvassing the market energetically to get supplies, but their efforts have met with little success. It is very difficult to find a mill able to give early deliveries of heavy material. At mills where operations have been resumed, there is no stability about prices. The market is making the best of present disabilities, catering for the most urgent requirements at special rates. There are, however, here and there, firms willing to quote forward. One Welsh firm has during the last day or two quoted £8 2s. 6d. for 10-ton lots of sections, and it is possible to get joists quoted at £8 2s. 6d., a figure which exactly parallels the foreign price, when certain differences with regard to extras are taken into consideration. It is believed that English and foreign prices will approximate closely for some time to come. Midland re-rollers claim to be still getting small emergency orders for angles at £9 10s. For deferred delivery they now quote £8 5s. Semi-finished material is also in brisk inquiry. British-rolled high-carbon billets, the price of which was recently advanced, are required in bulk. Any quantity of scrap is available. It is significant that, so far, there has been no great buying of scrap, a fact indicating that the works are heavily stocked with that material. There is an active demand for continental steel, especially constructional. Semis also continue in good demand. German shippers are off the market and the greater part of the billets now being imported comes from France. Prices are easier this week, £6 7s. 6d. or rather more. There is small expectation of English billets reappearing on the market yet awhile. Prices named without engagement as to delivery vary from £7 to £7 10s. Plans are now being made for getting into operation a number of the mills in the Black Country.

Raw Iron Values.

One can now, to some extent, gauge the price at which pig iron will be sold in this district when available. The re-lighting of furnaces is invariably a slow business. Blast-furnaces cannot be restarted till the coke ovens are got going again, and coke ovens which have been disused must run hazards before they can be relied upon to work efficiently. No furnace coke has reappeared on the open market as yet. A small cold-blast furnace has been commissioned in South Staffordshire, but other furnaces in the district have not the resources for resuming production. Two furnaces have been rekindled in Derbyshire,

and another in Lincolnshire. The new make of foundry iron is being offered at from £5 to £5 2s. 6d., delivered Birmingham — a figure 25s. per ton higher than that ruling before the strike, but in close proximity to that recently demanded by continental shippers. A prospect is held out of an early increase in the supply from Cleveland. Thus far, however, the high prices lately quoted have not receded by more than 5s. per ton. Lincolnshire foundry is quoted £5 2s. 6d., delivered Birmingham. It is extremely unlikely that any of the Northamptonshire smelters will be able to give supplies of pig iron this year, and much the same observation applies to South Staffordshire. Foreign pig irons have cheapened a little, now being offered at £4 17s. 6d. delivered.

Galvanised Sheets.

The anticipated further fall in galvanised sheet values has come to pass. With fuel more plentiful and cheaper, producers have realised the possibility of bringing down prices, even though sheet bars continue scarce and comparatively dear. Buying has recently fallen off and consumers need some inducement to place forward contracts. A number of mills this week therefore quoted £17 5s. for galvanised corrugated sheets of 24 gauge, though a few houses, better off for orders, held to last week's figure of £17 10s. for home business.

Fuel.

Fuel prices vary from day to day, and quotations lack uniformity. On 'Change in Birmingham to-day supplies were offered at rates substantially below those lately ruling. Compared with the spring prices, however, current quotations are still unduly high, and till they have subsided there is not much prospect of any considerable development in the heavy trades. Offers of blast-furnace coke are now coming forward at 40s. and upwards. Any such figure is, of course, prohibitive, except as a temporary expedient. On the price of coal and coke everything now depends.

Ironworkers' Wages Advance.

As a result of the rather high prices obtained by Midland ironworks for their output during the past two months, though it has been only sufficient to cover the extra cost of fuel used, ironworkers are now receiving under the sliding scale of the Midland Iron and Steel Wages Board a substantial increase in wages. Under the bi-monthly ascertainment an increase of 10 per cent. has been awarded. In October puddlers received an advance of 5 per cent. and the plussage to the basis rate of 13s. 6d. per ton is thus brought up to 60 per cent. The present award stands good until February 5th.

Stourbridge Ironworks Restart.

The works of Messrs. John Bradley and Co., Stourbridge, which have been standing idle since the end of April, in consequence of fuel shortage, resumed operations this week. Some subsidiary works of the company, which have run intermittently during the coal stoppage, will, it is hoped, resume fully in the near future.

The Cannock Chase Agreement.

A most satisfactory feature of the district settlement of the coal dispute in the Cannock Chase coalfield is that the agreement come to is to remain in force for at least four years. Short of a definite breach of contract by one side or the other, therefore, there will be no further stoppage in the Cannock Chase coalfields before 1931. That security, from the points of view of the men, the mine-owners, iron and steelmasters, manufacturers and the public, is most satisfactory. It is worthy of note that in this agreement there has been a certain amount of give and take, and on the whole the conclusion appears to be just and acceptable all round. While the men have had to agree to an eight hours' day, they have gained rather than lost so far as wages are concerned, for though the minimum is to be 42 per cent. on basis rates instead of the slightly larger percentage operating in April, they are to receive until the end of next May wages varying from 72½ to 70 per cent. above the basis rates, which will enable them to earn amounts comparable with the highest wages paid in the district since 1924. After May the system of monthly ascertainments will be put into operation by a district wages board equally representative of miners and coalowners, so that the miner will receive his due share of the proceeds of the industry. It is to be hoped that he realises that his own output will influence his future earnings.

Miners' New Union.

The idea of forming a new industrial union for miners which shall be free from political influences is gaining ground in the Midlands. Last week I recorded that the Notts. miners had proposed such an organisation. This week members of the Derbyshire Miners' Association held a meeting and definitely decided to form a new union for the county, to be free from all political party connections, and a further meeting has been fixed to formulate the constitution.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Engineers and Rates.

A STRONG line has been taken by the directors of the Manchester Chamber of Commerce regarding the industrial effects of high rates, culminating in the unusual step of appointing a deputation, headed by Sir Percy Woodhouse, the President of the Chamber, to wait upon the Lord Mayor and the chairman of the Finance Committee and other civic officials. The influence of local taxation on the engineering industry was set out in the course of a memorandum based upon data furnished by representative firms in the Manchester district. In this industry, it was pointed out, competition from several countries was now so exceptionally keen that tenders had to be cut to the bone. In one case, it was found that the local rates were equivalent to ·35 per cent. of the turnover in 1913, a figure which had risen to 1·5 per cent. in the current year. Expressed as a proportion of the overhead expenses in 1913, rates were 1·14 per cent., and in 1926 3·16 per cent., whilst in another case the rates were 1·9 per cent. in 1914 and 3·7 per cent. in 1926. Wages in the engineering industry have been reduced much more than in some occupations, such as corporation services and other sheltered trades which are not exposed to foreign competition, yet one engineering firm pointed out that the rates on cottages occupied by its workmen had risen from 2s. 3d. per week in 1913 to 4s. 9d. per week in 1926. The point was emphasised that such an increase not only affected the total cost of manufactures, for the increase in rates was a factor in fixing wages, but so long as the workpeople had to pay these heavy rates the prospect of improving the margins which they had for the other necessities and amenities of life was very dubious. It is expected that as a result of this step a further conference between representatives of the city authorities and of the Chamber of Commerce will take place in the near future.

Telephone Developments.

Manchester's progress in telephone equipment is indicated in a report for the year ending September last just issued by the superintending engineer, Mr. W. J. Medlyn. Several additional long distance circuits from Manchester and the surrounding industrial areas to London have been brought into use by means of the various repeater stations associated with the main underground cable routes. The temporary repeater station at Manchester is equipped with 65 repeaters, of which 53 are already in use, and permanent equipment of the latest type will shortly be provided in Manchester's Head Post Office for 90 repeaters, with an ultimate provision of 300. The underground wire mileage increased during the year by 53,412 miles, and in the fourteen years from 1912 to 1926 it has risen from 75,476 to 299,538 miles. In the same period the number of telephone installations has risen from 32,946 to 76,433, and in the year under review 10,679 new telephones were installed, representing a net increase of 5475.

The General Outlook.

The Manchester Chamber of Commerce, reviewing the position in the engineering industry in the course of a general industrial survey, states that the engineering trade was a little better during the past month, inquiries having become more numerous after it was clear that the coal stoppage could not last much longer. Not many of the inquiries, however, led to immediate business owing, in part, to the uncertainty as to what coal and foundry iron would cost in the next month or two. The heavy electrical section continued to do fairly well, considering the circumstances, and motor manufacturers stated that they had booked a large number of orders at the London Show, but textile machinists, boilermakers and machine tool makers had a dull time. A moderate amount of work was done in locomotive building shops, but they were not all fully engaged.

Non-ferrous Metals.

All sections of the non-ferrous metals are lower at the time of writing than they were a week ago. In the case of tin, the increase in available supplies shown by the month-end statistics, instead of a decline as the "bulls" seemed to expect, may have had some influence, although in view of the comparative smallness of the increase—from 14,200 tons at the end of October to 14,500 tons at the end of November—its effect might very easily be exaggerated. For so temperamental a metal as tin, however, the decline has not been of much moment, although there has been a further widening of the margin between the spot and three months' positions, the latter now being below the £300 mark. There has been only a moderate trade demand for copper. At times in the course of the week values of this metal lost some ground, but at the moment the undertone seems steadier and holders appear to be less anxious to sell. Lead is also displaying a stronger feeling, and an improvement in trade buying in this section of the market is looked for. Spelter is fairly steady and at times a better demand has been experienced.

Iron.

There seems to have been little extension so far in the number of blast-furnaces in operation in the Midland counties compared with last week, and the position as regards supplies of common irons is little if any better than it was, fuel supplies still being the deciding factor. No startling developments may be looked for now until after the New Year. In the meantime, users are not buying much of the foundry iron that is being offered for prompt delivery. For Scottish No. 3 pig iron current quotations for small lots for early delivery now range from 132s. 6d. to 135s. per ton, and for Middlesbrough No. 3 from 127s. 6d. to 130s. per ton, including delivery to works in the Manchester district. Lower rates than these, are, of course, being quoted in connection with forward transactions, although they are a long way from being uniform, Scottish varying from 110s. to 120s. per ton delivered, and Middlesbrough from 97s. 6d. to 100s., with Lincolnshire quoted at from 92s. 6d. to 100s., and Derbyshire at 95s. to 100s., although in the two last cases these prices are indicative of the market feeling rather than of firm quotations. Bar iron is in slow demand, but values are unchanged at £12 10s. per ton for Crown quality and £11 5s. per ton for seconds.

Steel.

There has been a moderate inquiry for steel during the past week, and prices keep firm pretty well all round. As regards supplies, however, there is very little available for immediate delivery, and it is not improbable that deliveries of Scottish material will be offered first owing to the fact that a start can be made in Scotland without the need for an early stoppage for the Christmas holidays, as would be the case at the English rolling mills. For joists and sections from £8 2s. 6d. to £8 5s. per ton is being asked here this week, with tank plates at £8 15s. to £9, boiler plates at £11 10s. to £11 15s., and basic steel bars at about £9 5s. per ton. For basic billets for wire drawers, £9 5s. per ton is being asked, and £10 10s. for acid billets. Re-rolled bars are rather easier at £9 10s. per ton delivered, and only a slow inquiry is reported. Prices asked for imported steels keep fairly steady, and little change compared with a week ago has occurred, although, as before, the demand for this material is relatively quiet. Billets are being offered for delivery in the Manchester area at £6 2s. 6d. per ton, with sheet bars at £6 7s. 6d, steel bars at £6 15s., light plates at £7 10s., Siemens plates at £7 15s., and joists and sections at about £6 15s. per ton. At the moment there is little business being done in galvanised sheets, and present prices range from £17 to £17 5s. per ton for February-March delivery.

Scrap.

For non-ferrous scrap values in most sections are maintained, and there has been rather more inquiry this week, although not much improvement in actual business. Scrap lead is on offer at about £29 per ton, zinc at £25 10s., clean light copper at £56, braziery copper at £52, brass rod turnings at £39 to £40, and selected gun-metal scrap at £52 to £53 per ton, for graded materials, delivered to buyers' works.

BARROW-IN-FURNESS.

Hematite.

The position is gradually changing, and the fact that more than one train with coke has arrived in the district is evidence that it will be but a short time before the furnaces are in blast again. Makers are keen to get started, but are wary about placing orders for fuel until normal prices obtain, and as regards coke the air is not quite clear as to price yet. The price of coke is an important factor to the maker who is committed to heavy tonnage booked at a price which will not bear any extra charges. However, the position will right itself in a few weeks, and in the meantime no reliable prices are available for coke from the East Coast. The market is not busy, for the very obvious reason that all consumers and merchants are well covered for a considerable period—not less than six months. There is a good outlook for the iron producers, for they are assured of a steady run for practically twelve months what with the orders they hold and further contracts which will come along in due course. This applies not only to the ordinary qualities of mixed Bessemer numbers but also to special qualities which will experience a good market.

Iron Ore.

As in the iron trade so in the iron ore trade also. The mines will soon be starting and there will be a steady flow of orders locally. What the Scottish requirements may be it is difficult to judge, but it is assured that outside business will be better than when the stoppage came. The same remark applies to foreign ore, but freights may affect the price of that material.

Steel.

The steel makers when they get their mills going again will have work to start upon which will keep them going for about six months, and, added to that, there is the possibility of further orders being booked when the time of delivery can be more definitely fixed. There is a very good outlook for the hoop mills, and also the small section mills, particularly the former.

SHEFFIELD.

(From our own Correspondent.)

No Resumption of Steel Production.

THE effect of the settlement of the coal strike is scarcely felt in Sheffield yet. The bar iron works of the district, only one of which was running during the trouble, have restarted operations, but the production of open-hearth steel for general purposes is still in abeyance. There is not much sign of preparations for the restarting of the great plants at Templeborough, Parkgate, Rotherham and Penistone, and it is not probable that they will be in operation before the New Year. Consequently, stocks of steel continue low, and the difficulties of manufacturers are not yet lessened. A number of firms have made use of electric furnaces for the melting of steel for their own purposes, but the quantities are comparatively small. There are no large deliveries of coal yet, owing to the shortage of railway wagons in colliery yards. The question of the future price of coal is still unsettled. A number of firms were able, during the strike, to enter into forward contracts at prices 2s. or 3s. in advance of those ruling before May, and merchants are now delivering against these contracts, as far as supplies permit. Firms receiving these supplies are benefiting greatly, as, instead of the 50s. or 60s. or more which they have been paying during the stoppage, they are now getting their coal at about 23s. or 24s. It is, however, hoped that prices will come down still further. Sheffield does not want to pay more, but less, than pre-strike prices for its coal. A reduction to something under 20s. per ton is urgently desired, and it is believed that if it could be secured a great improvement in trade would immediately follow.

The Tool Trades.

Orders for circular saws and various kinds of engineers' small tools have shown a drooping tendency during the past month, and it is not expected that any improvement will be manifested this year. It is hoped that operations on a normal scale will be resumed in the New Year, though the amount of work actually booked is not large. The Admiralty is inviting tenders for 3000 gross of hacksaw blades. For files, orders are coming in rather more freely than of late, but the demand is still

only moderate. The trade is still suffering from want of supplies of its ordinary raw materials, and cannot progress far towards revival until more acid steel is available. From a profit-making point of view, the file trade has had an unsatisfactory year. While it has been possible, in several branches of trade, to pass on to the consumer some share of the increased cost of production, this has not been the case with files, makers of which are bearing the losses resulting from the use of costly fuel.

Trade with Russia.

One cause of the slackness of the file factories during the second half of this year has been the absence, to a very large extent, of orders from Russia, which country has been doing very little business in Sheffield products. There are now some hopes of improvement in that quarter, as inquiries have just been received for quantities of files, edge tools and mechanics' tools. One or two orders for small tools have actually been placed, but they do not represent any great weight of work. Extended credit is required, and, owing to this condition, firms suffering from financial stringency are ruled out. At the moment, it cannot be said whether the inquiries will result in substantial business.

Colliery Equipment.

At the Denaby and Cadeby Main collieries, which are shortly to be amalgamated with Dinnington, Rossington and Maltby Main, extensive improvements of plant are nearing completion. A sum of £300,000 has been expended, and, as much of the work has been carried out during the stoppage, the pits restart work with an improved equipment for dealing with a greater production of coal. One of the principal additions is the installation of a pulverised fuel boiler plant at Cadeby Colliery, which will be in operation within a few weeks. It is designed for the utilisation of a very low grade of fuel, which has hitherto been regarded as a more or less waste product. The plant includes three John Thompson boilers, two raw coal silos, and two pulverisers. Instruments for checking the performance of the plant at all points are attached. The main contractors were the Fraser and Chalmers Engineering Works, of Erith, and the sub-contractors King, Taudevin and Co., of Sheffield, for buildings and brickwork, and J. Thompson and Co., of Wolverhampton, for boilers.

A Loss to Grimsby.

It is announced that Peter Dixon and Son, Ltd., paper manufacturers, of Oughtibridge, near Sheffield, and Grimsby, have purchased water power rights with a capacity of 20,000 to 30,000 horse-power, together with a large area of forest and farm lands, in Northern Finland, and that it is their intention to form a Finnish company for the purpose of converting the energy and material into pulp for their English mills. Messrs. Dixon state that their first intention was to erect a pulp factory near their paper mill at Grimsby, but inability to arrange favourable terms with the railway company caused them to look elsewhere. They had acquired an option on 70 acres of land between Immingham and their Grimsby mill. The undertaking would have been a big one, for the estimated outlay on the buildings for the works and the workmen's village would have entailed an expenditure of over £300,000. They approached the railway company to ascertain what it would do to meet the extra traffic that would be placed upon its system, as the new works would have meant the handling of about 90,000 tons of timber and upwards of 40,000 tons of pulp per annum, distributed between the paper mills at Oughtibridge and Grimsby. The railway rates at present in force are between 60 and 70 per cent. above pre-war rates. The firm also asked the railway company to carry from South Yorkshire collieries 1500 tons of coal per week, which it would require at its Grimsby mill, at the same rate of freight that is being charged to coal exporters, thus relieving Messrs. Dixon of the penalties imposed on British consumers of coal in favour of foreign consumers who are probably manufacturing the same products as themselves. At present this handicap on coal amounts to approximately 1s. 9d. per ton. Messrs. Dixon considered that by establishing an entirely new industry they were entitled to some consideration and considerable assistance. The railway company, however, declined to grant any special facilities to Messrs. Dixon, and hence the scheme fell through.

Shipbuilding Items.

It is good news for those who are interested in the steel trade to hear that Vickers Ltd. have received an order from the Admiralty for the construction of three submarines at Barrow. It has been stated that the craft will cost over £500,000 each. As soon as the steel material is available, the firm will be able to employ about 1500 more men in the shipbuilding and engineering departments of its Barrow works. The building of the three vessels will occupy about two years. The Almeda, which is one of three large passenger and cargo steamers which Cammell Laird and Co., Ltd., are constructing for the Blue Star Line, has successfully carried out her official trials on the Clyde and has returned to the Mersey. She is intended for service between London and the Argentine, and has a length of 510ft., a moulded breadth of 68ft., and a load displacement of 24,000 tons.

Cutlery and Plate.

There is a fairly good request for cutlery and plated goods of the highest quality, including ivory-handled knives, expensive pen and pocket knives, and sterling silverware, but the volume of this trade is not really large. The trade in stainless table cutlery is fairly strong, though the output is not equal to that of last year. A similar remark applies to spoons and forks, makers of which have enjoyed considerable activity throughout the year. Generally speaking, trading in these departments has produced little or no remuneration, owing to the severity of competition and consequent price reductions.

A Spanish Concession.

As a result of its energetic protests against the recent Spanish Royal Decree—which practically prohibited the importation of steel into Spain—the Sheffield Chamber of Commerce has been notified of a concession, though it is only a slight one. If the Spanish authorities find that their own steel manufacturers cannot satisfy the requirements of a Spanish customer, a permit is issued allowing the material to be purchased in this country. Until recently this permit operated for a month only, and Sheffield manufacturers found it impossible to execute orders in this short time, as in cases of out-of-the-way ports it takes three weeks for the material to reach its destination. The Spanish authorities have now agreed to allow these permits to be available for six months.

NORTH OF ENGLAND.

(From our own Correspondent.)

Industrial Revival.

The return to work of the Durham miners has enlivened the spirit of quiet optimism prevalent in the North of England regarding trade prospects, and it is generally anticipated that there will be much activity as soon as the all-important problem of regularised fuel supplies is straightened out. In the iron and steel trades large orders have accumulated, and appearances suggest that there will be more continuity of work than for some years past. It will, however, be some time before the full effects of the resumption of work can be enjoyed by the allied industries, such as shipbuilding, engineering, locomotive building, &c. The reason is that they have been more affected by the lack of iron and steel materials than of coal. Meanwhile, no time is being lost by iron and steel manufacturers in getting idle plant into operation once more. Already eight blast-furnaces are working on the North-East Coast, and by the end of next week it is expected that there will be eighteen to twenty in operation. The quickening activity at the steel plants will, of course, receive a further impulse when an increase in the pig iron supplies permits an expansion in the steel output. A remarkable recovery is being made in the Northern coalfields. In Northumberland there is said to have been a return to what is practically a normal state of affairs. Great satisfaction is felt at the result of negotiations with regard to Sunday working at some of the collieries, in the retention of the Sunday morning working shift. Many of the Durham pits have also resumed this week, affecting many thousands of men.

Cleveland Iron Trade.

Although a number of furnaces are now in operation, no hope is held out to consumers of a resumption of deliveries of pig iron this month, and special rates are still being paid for prompt iron. By the beginning of January, however, it is hoped that a certain amount of iron will be available, and for January–February delivery Cleveland makers are quoting 87s. 6d. per ton for No. 1 foundry, 85s. for No. 3 G.M.B., 84s. for No. 4 foundry, and 83s. for No. 4 forge. The prompt prices of these qualities are :—No. 1, 117s. 6d.; No. 3 G.M.B., 112s. 6d.; No. 4 foundry, 111s. 6d.; and No. 4 forge, 111s. per ton. Naturally, only those buyers who are in urgent need will pay the higher figures, and everyone who can do so is prepared to wait. The fact is that the coal dispute led to the suspension of many forward contracts which have yet to be implemented, and local makers will have a lot of iron to deliver early next year at pre-strike prices, which, of course, do not cover prospective costs of production. These deliveries will tide many works over the early months of the next year, and as orders have been booked for deliveries of No. 3 G.M.B. over the second quarter of next year at 82s. 6d. per ton, it is clear that a further fall in prices is anticipated when the first rush of material is satisfied.

Hematite Pig Iron.

Supplies of East Coast hematite are likely to be very limited for some time to come. With fuel at its present price, the independent makers cannot think of re-starting, and the bigger combines will need most of the hematite they produce for their own steel works. Still, there is a little material offered forward, makers' ideas being in the region of 90s. per ton over the first quarter of next year and for later deliveries 87s. 6d.

Ironmaking Materials.

Coke is still at a prohibitive price. For good blast-furnace coke as much as 35s. per ton has been paid, and the prompt price is not less than 30s. per ton at the ovens, which is equal to about 33s. 6d. per ton delivered. For January delivery about 25s. per ton at the ovens might be accepted, but ironmasters consider that that should be the delivered price, and many blast-furnaces are likely to remain out of commission until the lower figure for coke is touched. The foreign ore trade is still inactive, simply because there is no tonnage available. Works generally, however, have large stocks, and deliveries under old contracts later on will relieve them of the necessity of making fresh purchases until the market assumes a more natural level.

Manufactured Iron and Steel.

Finished iron and steel manufacturers have heavy order books, and inquiries are on a very satisfactory scale. A large number of steel furnaces are now in operation, and rolling operations have been started at some works. An advance of 10s. in the price of common iron bars is announced this week, these being now quoted at £12 5s. per ton. Galvanised corrugated sheets are a little easier at £17 for 24 gauge, and black sheets steady at £12 5s. Other minimum prices are unchanged.

Imports and Exports of Iron and Steel.

Shipments of iron and steel from the Cleveland district during November totalled only 17,459 tons, comprising 1141 tons of pig iron, 2896 tons of manufactured iron and 13,422 tons of steel, as compared with a total of 26,955 tons during October. Of the pig iron loaded last month, 906 tons went to foreign ports and 235 tons went coastwise; of the manufactured iron cleared, 2152 tons went abroad and 744 tons coastwise; and of the steel shipped, 9661 tons went overseas and 3761 tons coastwise. Statistics issued this week by the Tees Conservancy Commission show that during October and November imports of iron and steel to the Tees, comprising pig iron, bars, billets, blooms, slabs, plates, angles, rails, sheets and joists, from European countries, India and coastwise, totalled 89,598 tons, as compared with 32,628 tons for the same months a year ago and 14,855 tons for the corresponding pre-war period of 1913.

The Coal Market.

Under a steadily increasing production, coals are being freely offered on the Northern coal market, and fitters find the utmost difficulty in clearing their daily increasing output in response to local or even home demand. Supplies cannot be shifted to any distant home stations by rail on account of causing a serious wagon shortage. The demand for coastwise shipments is not sufficient to clear the excess output, and the opinion is very strong that the export trade should be made an open market. Northumberland coals are now being offered freely, and every grade is abundant for prompt clearance. The Durham qualities are also in good supply, and within the next few days there will be supplies in excess of all home requirements, and producers will have to seek foreign trade to keep the pits at full work. Prices are rapidly falling, and practically all descriptions show substantially reduced values. Best Northumberland steams are quoted from 23s. to 25s. per ton, with seconds at 22s. to 23s., smalls at 16s. to 17s. 6d., and secondary smalls at 14s. 6d. Durham best gas is about 25s.; second gas, 23s. 6d.; coking coals, 22s. to 25s.; and best bunkers, 24s. There is a fairly good supply of gas coke on offer for export shipment at 45s.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding Contracts.

Several new shipbuilding contracts have been placed with Scottish firms within the past few days, chief amongst them being the following :—Two motor-propelled oil tankers of 15,000 tons deadweight each, to be built by Alexander Stephen and Sons, Linthouse, for the Standard Oil Company, New Jersey. These vessels are to be built on the new bracketless system introduced by Sir Joseph Isherwood. The Caledon Shipbuilding Company, of Dundee, has also received an order for two motor-propelled oil tankers. The vessels, each of 10,000 tons deadweight, are to the order of the British Tanker Company, Ltd., London.

Early Resumption Anticipated.

Evidence is not lacking that producers of steel and iron are putting things in order in anticipation of an early restart of operations at those works which have been wholly closed down since the beginning of last May. Steel works in Lanarkshire are reopening immediately. Six furnaces have been relit, and a strong effort will be made to restart rolling mills next week. Furthermore, two pig iron furnaces in Ayrshire have been relit. The all-important factor is the price of coal; many producers have plenty of orders on hand, but will not begin operations until fuel is considerably cheaper than at present; but others are going ahead, confidently anticipating that fuel will be procurable at an economic price.

Steel and Iron.

While the whole outlook has improved by the conclusion of the coal strike, there has, so far, been no change in the actual volume of business done. Steel sheet-makers are still well employed, and outputs are readily disposed of at current prices. It is expected that several tube works will restart within a few days. Most classes of material are naturally very scarce, and firm prices are obtainable for immediate requirements. Several bar iron works are once again producing iron, and others will soon be in operation. Re-rolled steel bars still have a ready market. Steel and iron prices are all very firm, but it is anticipated that with coal becoming cheaper some decline in quotations will soon be announced. Two furnaces in Ayrshire have been relit, and supplies should soon be available from that source. No change has yet taken place in quotations named for delivery on the resumption of work at the furnaces, but with the cost of pig iron a basic factor in the steel and iron industries, no doubt an early return to pre-strike levels will be accomplished.

Coal.

The conditions governing the coal industry have shown little alteration during the week. Supplies of fuel are more than ample to meet all demands, and prices continue to weaken. Export demands or inquiries have expanded, but those collieries in a position to supply under permit are finding it almost impossible to meet the foreigner in the matter of price. In some cases merchants dealing in household coal have been literally inundated with offers of fuel, and while best qualities have mantained a fair average price of about 40s. per ton at the pit, second qualities have fallen as low as 30s., with inferior qualities somewhat lower still. For inland sale screened steam is quoted 25s. to 27s. 6d.; unscreened, 22s. 6d. to 25s.; treble nuts, 29s. 6d.; double nuts, 27s. 6d.; single nuts, 24s. to 25s.; pearls, 20s. to 22s. 6d.; and dross, 17s. 6d. to 20s., all per ton f.o.t at pit. For export screened steam is 25s. 6d.; unscreened, 21s. 6d.; trebles, 28s. 6d.; doubles, 27s. 6d.; singles, 24s.; pearls, 20s.; and dross, 17s. 6d. to 18s. per ton f.o.b.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Position.

CONDITIONS are settling down in the coal industry, but it will be some time before they can be described as anything like normal. The majority of the miners were back at work at the end of last week, and outputs of coal are fairly good, but it is questionable whether the figures have reached the total that was expected in some quarters. The fact is that at many collieries there has been a very considerable amount of repairing work to be done preparatory to production. Quite a number of undertakings are not, so far, getting more than about one-third of their usual output, though it is probable that the next week or so will see a marked improvement. In some areas the resumption of work has taken place without any sign of trouble, but in others there are indications that the men are somewhat restless, the allegation being that the managements are victimising some of the workmen. There is no doubt that it will be some time before anything like the full number of miners will find employment, if, indeed, they do at all, and that is bound to cause some dissatisfaction. On the business side there has been a fair amount of activity, especially considering the comparatively high prices which have been ruling. Tonnage has been chartered for practically all directions. The surprise is that there is so much tonnage being offered for employment. It was thought that it would be scarce, but the position is that orders are not really numerous in comparison with normal conditions, and after the first burst of activity there is inclined to be a lull in operations, as exporters are finding that foreign consumers display a tendency to hold off the market for coal prices to sink to a more reasonable level. The coalowners have all along been making representations through the secretary of their organisation for a removal of the restrictions upon exports. Permits, except for a few descriptions of coal, have not been difficult to obtain, and on Tuesday of this week the welcome news came to hand that releases for all qualities, apart from anthracite, bituminous smalls and coke, would be granted automatically, though applications have still to be made to the Custom House. The official announcement pointed out that permits for anthracite and bituminous smalls would be considered sympathetically, but the export of coke is prohibited.

Coalfield Items.

There are, of course, some pits which will in all probability never be reopened for work. One such case is that of the Gellyceidrim Colliery, Glanamman, where about 650 to 700 men were employed. Representations were made to the owners, the Amalgamated Anthracite Collieries, Ltd., by the workmen, but the latter have been informed that the decision to close down at this colliery is irrevocable. On the other hand, better news comes from other areas. It is announced that Baldwins, Ltd., are installing the latest types of coal getters at Aberbaiden and Newlands collieries, which will revolutionise the conditions there. American coal-cutters are being put in at Newlands Colliery, and Messrs. Anderson and Boyce's English short-wall cutters at Aberbaiden Colliery, so that the proprietors will be able to judge of the relative effectiveness of these labour-saving machines. For some time prior to the stoppage three out of the four pits belonging to Locket's Merthyr undertaking at Mardy were closed, but the company has now decided to reopen all four pits for employment.

Expanding Employment.

There are all round signs of an improvement in employment in this district. The ship-repairing industry is showing more activity. As expected, the resumption of work in the coalfield is bringing round to South Wales increased supplies of tonnage, and that, of course, means that shipowners who desire any repairs to be effected look forward to having them done at the port at which the steamer is likely to load a cargo outwards. Whereas a week or two ago almost all dry docks were empty, the position now is that most of them are occupied. It may be that the repairs in most instances are not very substantial, but it is a distinct change to have so many steamers requiring repairs, even of a general character. Additional tin-plate mills are operating and steel works are resuming. Furnaces have been lighted up at the Albion Steel Works at Briton Ferry, and at the Llanelly Steel Company's works six smelting furnaces were put into commission on Tuesday, and arrangements have been made for a recommencement of one of the two bar mills. This will mean employment for 500 out of 1000 men engaged at these works in normal times.

Extensions of Combines.

Following upon the acquisition of a controlling interest in the United National Collieries, Ltd., by Ocean Coal and Wilsons, Ltd., referred to last week, comes official news relating to the big merger in the anthracite district. Provisional terms have been agreed by which the Amalgamated Anthracite Collieries, Ltd., amalgamate with the United Anthracite Collieries, Ltd., shares of the latter being exchanged for shares of the Amalgamated Anthracite Company on a share for share basis, but with a view to equalising their respective share values, shareholders in the Amalgamated undertaking will receive one fully paid share in respect of every ten shares held. The capital of the Amalgamated company is to be increased from 2½ million pounds to 5 million pounds in shares of £1 each. There are also rumours of another big fusion in this district, the firms mentioned being those of L. Gueret, Ltd., Messrs. D. R. Llewellyn Merrett and Price, Ld., and Lysberg, Ltd. This amalgamation, if it is carried through, will mean concentrating the production and marketing of between 10 and 12 million tons of coal and patent fuel per annum.

Trimmers and Tippers.

Negotiations have been proceeding for an extension of working hours at South Wales docks. The proposal put forward recently was that the trade should revert to the old system of a day and night shift, viz., 8 a.m. to 5 p.m. and from 9 p.m. to 6 a.m., with an hour for meals in each shift. The workmen are apparently opposed to this arrangement, and prefer to agree to a slight extension of hours on the present second shift for the purpose of finishing a vessel, provided they are paid overtme. Hopes are entertained that before very long an agreement will be come to on the question.

LATER.

As the result of further negotiations an agreement has been reached between the Great Western Railway Company and the coal tippers' delegates of the various South Wales ports regarding the company's proposals for working the split shift. The agreement is subject to confirmation by the men, and provides for the introduction of the new conditions on February 1st; though, if trade warrants it, they may be brought into operation earlier. Further negotiations are to take place respecting the trimmers.

Tin-plate Trade.

The resumption of work in the coalfield and reduced costs of fuel have brought about easier conditions in the tin-plate market. The tendency of buyers is also to hold off; whereas the market price recently was about 25s. 6d., prompt plates are now about 22s. 6d. basis I.C. f.o.b. works port, and business for the first three months of next year has been done at 21s. to 22s. It is announced that the agreement between the Briton Ferry Steel Company and the Morriston and Midland Tin-plate Company has been completed. Under this the former company acquires the latter, the purchase price being £164,000, representing about £350 per £100 share.

Market Conditions.

The coal market is perceptibly easier as compared with what it was a week ago, and as outputs increase, buyers are confident that they will be able to obtain supplies of coal on more favourable terms. The position at the moment is that values of best Admiralty large are round about 32s. 6d. to 35s., small coals ranging from 20s. to about 25s. In the anthracite section, best big vein large coals are quoted at from 45s. to 50s. and red vein large coals at about 40s. Anthracite coals are likely to hold steadier than steam coals. Buyers of the latter are holding off in the expectation that at the end of this year or early next prices will come down to the values prevailing just before the stoppage in the coalfield. The French State Railways are reported to have bought about 100,000 tons of Admiralty large coals for shipment over 1927 on the basis of about 24s. 6d. to 25s. f.o.b. The Belgian State Railways are in the market for 100,000 tons of through coals and 30,000 tons of small, for delivery over the first half of next year. Foreign coals are, of course, still coming to this district, and it is interesting to note that in the early part of this week there were twenty-six vessels at South Wales ports loading cargoes of coal outwards, while there were fifteen steamers in dock discharging cargoes of foreign coal. Pitwood ranges from 40s. to 45s.

INSTITUTION OF MECHANICAL ENGINEERS.

THE annual dinner of the North-Western Branch of the Institution of Mechanical Engineers was held on Thursday, Dec. 2nd, at the Engineers' Club, Manchester. Mr. Cecil Bentham, chairman of the branch, presided, and there was a large and representative company present. In addition to the customary loyal toast, there were the toasts of "The Institution of Mechanical Engineers," "The Guests," and "The Chairman." The first was proposed by Lord Cozens-Hardy, who said there was a tendency to do scant justice to the Institution owing to the formation of new institutions. With regard to the difficult questions involved in the terms and conditions of employment which had tended to hinder this country's recovery from the economic consequences of the war, the engineering industry had shown that, given courage and willingness on both sides to face the facts, the adjustments necessary to meet severe industrial depression could be effected peacefully, and the country owed much to the leaders on both sides in the engineering industry for the successful handling of these difficult questions. He did not think the same could be said of that great industry which had occupied so much of the nation's thoughts during the past few months. With that recent object lesson of the disastrous consequences of the mishandling of the problems involved, the time seemed to be ripe for a conference between the leading partners on both sides of the coal industry. He was convinced that a conviction of the futility of continued industrial strife had become widespread, and he could not but think that the common sense of the country would evolve the remedy for the disease before it had gone too far, and would insist on its application before it became too late. The toast was responded to by the President, Mr. W. Reavell, in a highly appropriate speech. He said that although the Manchester branch was not the first to be formed it speedily took the first place amongst the branches of the Institution, its membership now numbering 1129. It was easily the largest branch of the Institution. Mr. Harold F. Massey, who is to be nominated by the local committee at the annual general meeting as chairman of the branch for the coming year, proposed "Our Guests," and the toast was acknowledged by Captain R. S. Hilton and Mr. E. D. Simon, M.A., M. Inst. C.E. The health of the chairman, Mr. C. Bentham, was submitted by Mr. Daniel Adamson, Vice-president of the Institution. In a graceful acknowledgment of the toast, Mr. Bentham referred to the assistance which he had received from the local committee, and particularly from the honorary secretary, Professor Dempster Smith, whose approaching retirement from the post of honorary secretary was announced. Professor Smith has occupied that post ever since the formation of the branch, and has contributed very largely to the success which had attended it.

CATALOGUES.

G. AND J. WEIR, Ltd., Cathcart, Glasgow.—Booklet illustrating and describing Weir high-pressure air compressors.

D MILNE AND SONS, Park-road, Aberdeen.—A number of illustrated leaflets of shears and presses with a price list.

CROFTS (ENGINEERS), Ltd., Thornbury, Bradford.—Circulars on variable speed gears and power transmitting appliances.

THE AEROGRAPH COMPANY, Ltd., 43, Holborn Viaduct, London, E.C. 1.—Pamphlet describing the "Aerograph" air purifier

CONTRACTS.

VICKERS Ltd. have received an order from the British Admiralty for the construction of three submarines.

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., has been successful in obtaining a twelvemonth's contract from the Great Western Railway for the supply of Mazda gas-filled lamps.

THE HAMWORTHY ENGINEERING COMPANY, of 76, Victoria-street, Westminster, has received a further order for one of its 100 cubic feet engine-driven compressor sets for use by the Egyptian Government.

THE Polish Government has ordered three submarine minelayers from La Société des Chantiers et Ateliers Augustin Normand, of Havre, La Société des Ateliers et Chantiers de la Loire, and la Société des Chantiers Navals Français.

JOHN I. THORNYCROFT AND CO., Ltd., of Woolston, Southampton, have received from the Central African Railway Company an order for six galvanised steel lighters, the principal dimensions of which are:—Length overall, 85ft.; breadth moulded at deck, 20ft.; depth moulded, 5ft. These lighters are of the swim type with square ends and square chine bilge, and will be towed.

THE POLYTECHNIC ENGINEERING SOCIETY: ANNUAL CONVERSAZIONE.—We are asked to state that the annual conversazione of the Polytechnic Engineering Society will be held on Friday, December 17th. Past members of the Society or others who require tickets are asked to write at once to the Secretary, 309, Regent-street, London, W. 1.

THE ROYAL AGRICULTURAL SOCIETY.—The eighty-sixth annual exhibition of the Royal Agricultural Society of England will take place at Tredegar Park, Newport, Monmouthshire, from July 5th to July 9th, 1927. The Council of the Society has accepted the invitation of the Corporation of Nottingham to hold the 1928 Exhibition in that city. Manchester will be the venue of the Show in 1930 and Warwick in 1931. The place of meeting in 1929 has not yet been arranged.

SCIENCE MUSEUM.—The official guide lecturer, Engineer-Captain E. C. Smith, O.B.E., R.N., conducts visitors on week-days round the Science Museum at twelve noon and 3 p.m., Saturdays at 2.30 p.m. and 4.30 p.m. Each tour lasts about an hour, and is devoted to one gallery. A list of the arrangements is issued monthly by the Museum. His services can also be obtained on week-days, except Saturdays, at other times without charge. Application should be made by letter to the director and secretary at least five days beforehand.

A CENTURY OF PERMANENT WAY.—Edgar Allen and Co., Ltd., have reprinted in a convenient and attractive form the lecture on Permanent Way which Mr. Fred Bland delivered at the annual Convention of the Permanent Way Institution in Sheffield on July 8th, 1925. Many of our readers will recall that the lecture contained many historically useful facts, and that it was illustrated by a large number of lantern slides. These slides are, we notice with pleasure, reproduced in the volume before us. Within the same covers a paper on Atmospheric Railways, which Mr. Bland contributed to the *Edgar Allen News* in July last, is also included, and particulars of manganese steel track-work are given.

THE JUNIOR INSTITUTION OF ENGINEERS.—At the inaugural meeting of the forty-sixth session of the Junior Institution of Engineers held at the Royal Society of Arts, Adelphi, on Friday, December 3rd, the president, Mr. J. S. Highfield, in the chair, Vice-Admiral Sir Robert Dixon, the new President, delivered the address which we reprinted in our last issue. On the same occasion medals and awards gained during the forty-fifth session were presented to the following members:—(*a*) The Institution Gold Medal to Mr. J. Wolstenholme for his paper "The Commercial Side of Foundry Work"; (*b*) Vickers Gold Medal and Prize to Mr. A. N. Moon for his paper "Comfort in Railway Travel from the Point of View of the Engineer"; (*c*) the Institution Silver Medal to Mr. E. Le L. Lamb for his paper "Electricity in Mining"; (*d*) the Durham Bursary of £25 to Mr. W. A. Sellis for his thesis "The Strowger System of Automatic Telephony"; and (*e*) the Past-Secretary Dunn Medal to Mr. F. E. Webb for his informal lecturette "Paint Spraying."

ROYAL INSTITUTION.—A general meeting of the members of the Royal Institution was held on Monday afternoon, December 6th, Sir Arthur Keith, F.R.S., Treasurer and Vice-president, in the chair. The Chairman announced that the Managers had elected Professor Julian Huxley Fullerian Professor of Physiology. The special thanks of the members were returned to Mr. Frank Scudder for his gift of a crystal model, nine lantern slides used by Sir Henry Roscoe in his lectures on Faraday, and a Franklin Medal in aluminium which belonged to Faraday; and to the Department of Scientific and Industrial Research for the gift of the whole of the apparatus and equipment used by Sir William Bragg in his researches on the X-ray analysis of crystals. Mr. W. H. Ballantyne, Mr. A. C. Eborall, Mrs. Eccles, Mr. W. C. Edwards, Dr. C. V. Drysdale, Commander J. O. Gawne, Mr. H. C. Holder, Miss McClean, Mr. J. A. Mundella, Dr. C. C. Murdock, Mr. E. A. Notcutt, Dr. Mata Prasad, Dr. J. M. Robertson, Mr. E. W. Rowntree, Mr. H. G. Spicer, Mr. W. A. S. Vardy, and Mr. C. P. Williamson were elected members.

THE HOUSE OF SABEN.—This is the title of the quarterly house organ of Sanderson Brothers and Newbould, Ltd., of Sheffield. Its present issue is a souvenir number to celebrate the 150th birthday of the firm, and is devoted to a history of the company and to an account of commerce, life and manners generally in this country during the past century and a-half. There are many excellent reproductions of old engravings, and the letterpress contains numerous facts and shrewd comments upon the changes that have taken place since the firm came into existence. "We are," writes the author, "learning the true attitude to nature and to life. Superstitions are giving place to a world-wide enlightenment that is opening new doors. Science is teaching us that the right way to successful achievement is to drop the superstitious nonsense about the 'conquest of nature' or of anything. Nature's lesson is that we must 'stoop to conquer,' that is, we must co-operate with her, by submitting to and working with her methods. Then she 'works' *for us* in producing more abundantly and in ever newer forms and varieties."

PHYSICAL SOCIETIES' EXHIBITION.—The seventeenth annual Exhibition of the Physical Society and the Optical Society is to be held on Tuesday, Wednesday, and Thursday, January 4th, 5th, and 6th, 1927, at the Imperial College of Science and Technology, Imperial Institute-road, South Kensington, and will be open in the afternoon (from 3 to 6 p.m.) and in the evening (from 7 to 10 p.m.). On January 4th, at 8 p.m., Professor E. N. da C. Andrade will reproduce with contemporary apparatus a physical lecture of the early eighteenth century. On January 5th, at 8 p.m., Dr. C. V. Drysdale will give a lecture on "Progress in Electrical Instrument Design and Construction," and on January 6th, at 8 p.m., Mr. J. L. Baird will give a lecture on "Television." These lectures will be illustrated by lantern slides and experiments. Some seventy firms will exhibit scientific apparatus, and in addition there will be a group of non-commercial exhibits by Fellows of the Societies and others, including demonstrations of famous historical experiments in physics, recent research and effective lecture experiments. It has been decided to open the Exhibition to the general public without tickets on the third day, January 6th. On January 4th and 5th tickets of admission will be required.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	18/6 to 21/-
(1) Spanish	18/6 to 21/-
(1) N. African	18/6 to 21/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	18/- to 21/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	—	—
No. 1 Foundry	‡4 17 6 to 5 0 0	—
No. 3 Foundry	‡4 12 6 to 4 15 0	—
‡ *For delivery after resumption of work at furnaces.*		
N.E. COAST—		
Hematite Mixed Nos.	*c*4 10 0	4 10 0
No. 1	*c*4 11 0	4 11 0
Cleveland—		
No. 1	*c*4 7 6	4 7 6
Silicious Iron	*c*4 7 6	4 7 6
No. 3 G.M.B.	*c*4 5 0	4 5 0
No. 4 Foundry	*c*4 4 0	4 4 0
No. 4 Forge	*c*4 3 0	4 3 0
Mottled	*c*4 2 0	4 2 0
White	*c*4 2 0	4 2 0
(*c*) *January - February Delivery.*		
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	10 10 0	—
North Staffs. Forge	3 17 6	—
„ „ Foundry	4 7 6	—
(3) Northampton—		
Foundry No. 3	4 5 0	—
„ Forge	2 16 0 to 2 17 0	
(3) Derbyshire—		
No. 3 Foundry	4 7 6 to 4 12 6	
Forge	—	
(3) Lincolnshire—	(*None offered.*)	
No. 3 Foundry	3 8 0	—
No. 4 Forge	3 5 6	—
Basic	3 6 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 15 6 (*a*) 4 18 6 (*b*) 5 2 0 (*c*)	— — —

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	12 0 0	11 0 0
Best	—	—
N.E. COAST—		
Common Bars	12 5 0	—
LANCS.—		
Crown Bars	12 10 0	—
Second Quality Bars	11 5 0	—
Hoops	14 0 0	—
S. YORKS.—		
Crown Bars	12 10 0	—
Best Bars	13 10 0	—
Hoops	14 10 0	—
MIDLANDS—		
Crown Bars	13 0 0	—
Marked Bars (Staffs.)	14 10 0	—
Nut and Bolt Bars	—	
Gas Tube Strip	12 10 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	11 0 0	—
Ship Plates, ¾in. and up *d*	8 2 6	7 0 0
Sections	7 12 6	6 5 0
Steel Sheets, under 3/16in. to ¼in.	12 0 0 to 13 0 0	
Sheets (Gal. Cor. 24 B.G.)	—	£17 10 0 to 18 10 0
(*d*) *Official Minimum, actual prices about 5s. more.*		

STEEL (*continued*).

N.E. COAST—	Home. £ s. d.	Export. £ s. d.
Ship Plates	8 12 6	—
Angles	8 12 6	—
Boiler Plates	12 0 0	—
Joists	8 0 0	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 2 6	—
Soft Billets	7 5 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 0 0†	—
Light Rails	8 5 0 to 8 10 0	
Billets	8 0 0 to 11 10 0†	
MANCHESTER—		
Bars (Round)	9 10 0	—
„ (Small Round)	10 0 0	—
Hoops (Baling)	11 0 0	11 0 0
„ (Soft Steel)	10 15 0	10 15 0
Plates	8 15 0 to 9 0 0	
„ (Lancs. Boiler)	11 15 0	—
SHEFFIELD—		
Siemens Acid Billets	11 0 0	—
Bessemer Billets	11 0 0	—
Hard Basic	9 2 6	—
Intermediate Basic	8 12 6	—
Soft Basic	7 15 0	—
Hoops	12 0 0	—
Soft Wire Rods	9 10 0	—
MIDLANDS—		
Small Rolled Bars	8 15 0 to 9 5 0	
Billets and Sheet Bars	—	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	17 5 0 to 17 10 0	
Angles	8 12 6 to 8 17 6	
Joists	8 12 6 to 8 17 6	
Tees	9 12 6 to 10 17 6	
Bridge and Tank Plates	—	
Boiler Plates	—	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	21/9 to 22/6
Block Tin (cash)	310 5 0
„ (three months)	298 5 0
Copper (cash)	57 7 6
„ (three months)	58 2 6
Spanish Lead (cash)	28 12 6
„ (three months)	29 1 3
Spelter (cash)	32 18 9
„ (three months)	33 0 0
MANCHESTER—	
Copper, Best Selected Ingots	64 5 0
„ Electrolytic	64 17 6
„ Strong Sheets	92 0 0
„ Tubes (Basis Price) lb.	0 1 1
Brass Tubes (Basis Price) lb.	0 1 0
„ Condenser lb.	0 1 2½
Lead, English	30 7 6
„ Foreign	29 5 0
Spelter	32 2 6
Aluminium (per ton)	£107

FERRO ALLOYS.

(*All prices now nominal.*)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10 per lb.	
Ferro Tungsten	1/5½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	7/6
„ „ 6 p.c. to 8 p.c. „	£22 0 0	7/3
„ „ 8 p.c. to 10 p.c. „	£20 15 0	6/6
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£37 0 0	12/6
„ „ „ 1 p.c. „	£43 0 0	15/-
„ „ „ 0·70 p.c. carbon	£54 0 0	17/6
„ „ „ carbon free	1/5d. per lb.	
Metallic Chromium	3/- per lb.	
Ferro Manganese (per ton)	£15 for home, £15 for export	
„ Silicon, 45 p.c. to 50 p.c.	£11 5 0 scale 5/- per unit	
„ „ 75 p.c.	£17 10 0 scale 6/- per unit	
„ Vanadium	14/3 per lb.	
„ Molybdenum	5/- per lb.	
„ Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£170	
Cobalt	8/6 per lb.	

FUELS.

SCOTLAND.

	(*Prices nominal.*)	Export.
LANARKSHIRE—		
(f.o.b. Glasgow)—Steam		15/9
„ „ Ell		16/6
„ „ Splint		16/6 to 17/-
„ „ Trebles		15/9
„ „ Doubles		14/- to 14/6
„ „ Singles		13/9
AYRSHIRE—		
(f.o.b. Ports)—Steam		16/9
„ „ Jewel		17/- to 17/6
„ „ Trebles		17/-
FIFESHIRE—		
(f.o.b. Methil or Burntisland)—Steam		12/6 to 14/9
Screened Navigation		21/-
Trebles		14/- to 15/-
Doubles		14/-
Singles		13/- to 13/6
LOTHIANS—		
(f.o.b. Leith)—Best Steam		14/- to 14/3
Secondary Steam		13/6
Trebles		14/6 to 14/9
Doubles		13/6
Singles		13/6

ENGLAND.

	Inland. (*Nominal, none on offer.*)
(8) N.W. COAST—	
Steams	28/-
Household	*No quotation.*
Coke	„ „
NORTHUMBERLAND—	
Best Steams	23/6 to 24/-
Second Steams	22/- to 23/-
Steam Smalls	17/6
Unscreened	20/- to 22/-
Household	33/- to 40/-
DURHAM—	
Best Gas	25/-
Second	23/6
Household	33/- to 40/-
Foundry Coke	—
SHEFFIELD—	
Best Hand-picked Branch	31/- to 34/-
Barnsley Best Silkstone	28/- to 30/-
Derbyshire Best Brights	26/- to 28/-
„ „ House	24/- to 25/-
„ „ Large Nuts	17/- to 20/-
„ „ Small	12/6 to 14/-
Yorkshire Hards	17/- to 19/6
Derbyshire Hards	16/- to 19/-
Rough Slacks	10/- to 12/6
Nutty Slacks	7/6 to 9/-
Smalls	3/6 to 6/-
Blast-furnace Coke (Inland)*	—
„ „ (Export) f.o.b.	16/- to 17/-

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	32/- to 33/-
Second „ „	30/- to 32/-
Best Dry Large	30/- to 32/6
Ordinary Dry Large	29/- to 30/-
Best Black Vein Large	27/6 to 30/-
Western Valley Large	27/6 to 28/6
Best Eastern Valley Large	27/6 to 28/6
Ordinary „ „	27/- to 28/-
Best Steam Smalls	22/6 to 25/-
Ordinary „	20/- to 22/6
Washed Nuts	30/- to 35/-
No. 3 Rhondda Large	35/- to 36/-
„ „ Smalls	25/- to 27/-
No. 2 „ Large	30/- to 32/6
„ „ Through	27/6 to 28/-
„ „ Smalls	20/- to 22/6
Foundry Coke (export)	40/- to 50/-
Furnace Coke (export)	25/- to 30/-
Patent Fuel	40/-
Pitwood (ex ship)	45/- to 7/6
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	47/6 to 50/-
Seconds	45/- to 47/6
Red Vein	39/- to 40/-
Machine-made Cobbles	57/6 to 60/-
Nuts	57/6 to 60/-
Beans	50/- to 52/6
Peas	29/- to 30/-
Breaker Duff	12/- to 12/6
Rubbly Culm	16/- to 17/-
Steam Coals:	
Large	30/- to 35/-
Seconds	22/6 to 25/-
Smalls	16/- to 17/-
Cargo Through	22/6 to 25/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire. (6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. * For blast-furnaces only, 17/-, with fluctuations according to analysis: open market 17/6 to 19/- at ovens. † Latest quotations available. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

Trade Decline.

THE last week or two has seen a steady decline in business which cannot be attributed to temporary causes, but can be logically explained by economical changes that are affecting all the countries on the Continent. The recovery of the franc has been so rapid that it has taken everyone by surprise, and it is having inevitable results which everybody had been endeavouring to guard against. Not long ago manufacturers found it necessary to lay in stocks at a time when values were rising, and the carrying of those stocks, which are constantly depreciating, is a serious factor in the situation. In view of the uncertain outlook, which leads to the belief that values will further decline, consumers are holding off the market, and business has fallen off to an extent that is causing serious uneasiness all round. Many of those who laid in stocks in anticipation of a continuance of the foreign demand are finding themselves in difficulties. Export inquiries have practically ceased, because the improvement in the franc has narrowed down the margin between home and foreign prices to a point where it is no longer possible to risk speculative buying. Moreover, French makers hesitate to take orders except for immediate delivery, because they do not know what they will have to pay for their material in the early future. While the purchasing power of the franc has increased, there has been no reduction in the prices of coal, coke and crude metal, and it is difficult to see how prices can become easier, in view of the higher quotations for coke from Germany. As no one will buy except for urgent requirements, the position of makers is becoming very unsatisfactory, and in some branches of the engineering trades the working day is being reduced, while the ranks of unemployed are steadily increasing. For the moment the unemployment difficulty is not serious, and the number of men out of work in the Paris district does not number more than a few thousand, but it is recognised that the difficulty is beginning to manifest itself, and will have to be taken into account very seriously in the early future. Manufacturers have, indeed, brought the gravity of the situation to the notice of the Government, in the hope that something will be done to prevent a disorganisation which cannot fail to have permanent effects. During this period, when so much capital is locked up in depreciating stocks, it is all the more necessary to obtain credit to carry on business, but as the banks have found it desirable to suppress credit altogether until the position becomes clearer, the result is that the monetary stringency is adding to the difficulties of manufacturers. Another factor is the belief that the termination of the miners' strike in Great Britain will enable that country to enter the continental markets. For six months Great Britain has been a valuable customer for continental iron, steel and fuel, and the recent prosperity of the continental industries has depended largely upon those requirements, and while it is probable that the larger supplies of coal now available will bring down prices, it is also feared that in face of the rising franc British manufacturers may find themselves in a position to under-quote French producers. It is, in fact, impossible to foresee what will happen, and it is this uncertainty which is giving rise to a general feeling of concern. It is pointed out, however, that the situation in France is far from being so bad as it was in other countries during the period of monetary deflation, and hopes are entertained that the present depression will give place to a renewed activity in the spring when consumers will be obliged to cover their requirements. Manufacturers themselves are preparing for every emergency to the extent that one of the largest firms in France, which has made a profit of 22,500,000f. on the year, has decided to carry the whole of that sum forward as an insurance against unforeseen contingencies.

The Steel Union.

The production of steel is being strictly adjusted to requirements, for while the Cartel increased the production a little while ago to meet the heavier demand, it is now found necessary to limit the output still further. The effect of this control is observable in the maintenance of prices, despite the heavily contracted consumption. Representatives of the Czecho-Slovakian industry will meet in Paris this week to arrange for the admission of the Central European steel producers into the Cartel. In all countries the consumption of steel is diminishing, and in Germany an effort is made to find new outlets, one of them being the construction of steel houses which are produced in large numbers with interchangeable sections, so that they can be erected on their foundations in a couple of days.

Air Lighthouses.

The most powerful lighthouse for the air service yet constructed has been put to work on Mont Valerien, outside Paris. While the lighthouse on Mont Sait Affrique, near Dijon, which serves as a guide for aeroplanes on their night journeys between the Channel and the Mediterranean, has a power of 800 million candles, the one on Mont Valerien has a power of a milliard candles, provided by two lenses, each of 2 m. diameter. It will be plainly visible over a radius of 60 miles. The Italian Government also proposes to erect a lighthouse on the top of Mount Etna as a guide for aircraft in the Mediterranean. As there is a constant and heavy wind all the year round, it is intended to utilise it for the production of the necessary electrical energy.

An Irrigation Barrage.

The first stone has been laid for the barrage which is to be constructed at Zardezas, about 36 miles from Philippeville, in Algeria. It will have a length of 180 m. and a height of 40 m., and will form a reservoir 500 acres in extent, and having a capacity of 35 million cubic metres. It is intended solely for irrigation purposes. The idea of carrying out this scheme dates as far back as 1860. Several other hydraulic undertakings are being carried out or projected in Algeria, and for several years to come this African department will be providing work for hydraulic and other engineers.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

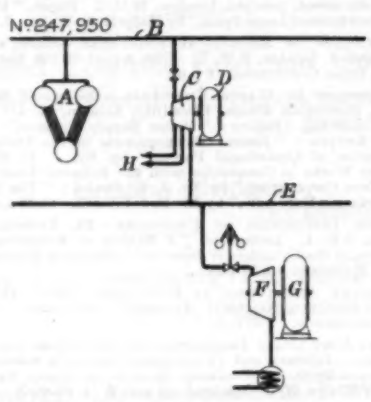
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

247,950. February 15th, 1926.—IMPROVEMENTS IN STEAM-DRIVEN ELECTRIC GENERATING PLANT, Siemens-Schuckertwerke Gesellschaft mit beschränkter Haftung, of Berlin-Siemensstadt.

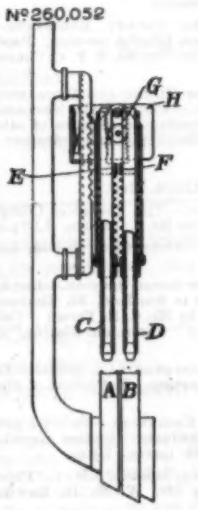
In accordance with this invention, alternating-current generators are driven by separate turbines, the generator dealing with the wattless energy being driven by a turbine working at a higher pressure than the other turbine. The high-pressure boiler A feeds the turbine C through a pipe B, D being the gene-



rator. From the turbine C exhaust steam is fed into the pipe E, which feeds the turbine F. The power factor of the generator G is improved by the entire or partial taking of the wattless current by the generator D in such a manner that either the total effective output or energy of both machines is improved or a better distribution of the wattless energy is ensured. The auxiliary turbine C is provided with several tappings H for feed-water heating. The pipe E might be connected to a low-pressure boiler. The advantages claimed for the scheme are fully described.—*October 21st*, 1926.

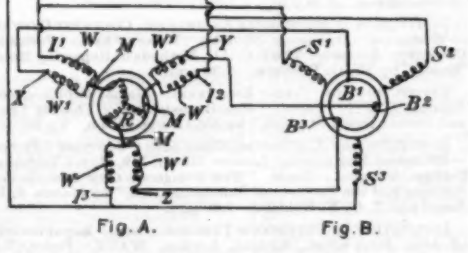
260,052. July 25th, 1925.—IMPROVEMENTS IN AND RELATING TO CURRENT COLLECTING DEVICES FOR DYNAMO-ELECTRIC MACHINES, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, W.C. 2, and Allan Adair Pollock, of Croxton House, Sherborne-place, Leamington Spa.

The brush-holder illustrated is of the duplex type in which the brush is divided into two portions and the object of the invention is to ensure that both sections make good contact with the commutator, irrespective of the fact that the two parts of the brush may wear away at unequal rates. If the brush portions A and B wear at an equal rate then both plungers C and D move down by equal amounts and the pressures on the brushes remain equal. If, however, one portion of the brush wears more than the other then the tension of the spring pressing on that section becomes less than that on the other section and relative movement of the sliding sleeves E F will take place; that is to say, one will move downwards while the other moves upwards owing to their being mechanically connected by the pinion G, the movement continuing until the pressures on the two brush portions are equalised. The pressure on both sections of the brushes can be altered simultaneously by raising or lowering the bracket H. A device such as that described avoids the necessity for periodical readjustment of the spring tension on duplex brush gear when one section wears quicker than the other.—*October 28th*, 1926.



260,337. July 27th, 1925.—IMPROVEMENTS IN DYNAMO-ELECTRIC MACHINES, The Electro Dynamic Construction Company, Ltd., and Nicolo Pensabene, both of 6, Maltstreet, London, S.E. 1.

This invention relates to improved means for regulating the

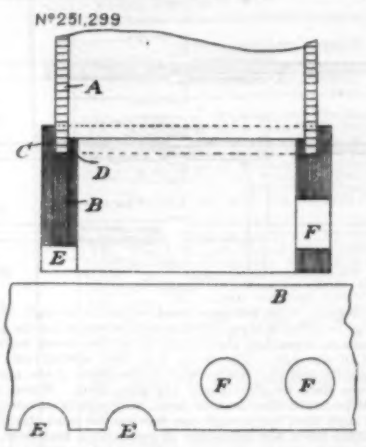


speed of polyphase motors of the induction type with commutators. The accompanying diagram illustrates a two-pole three-phase induction regulator Fig. A controlling a three-phase commutator motor Fig. B, having a stator winding S_1, S_2, S_3, and a commutator with brushes B_1, B_2 and B_3. The regulator stator consists of three phases, each having windings W W_1 connected to a common part M. The windings placed in the rotor R are connected star fashion. If a three-phase voltage is applied to terminals I^1, I^2, I^3, a three-phase supply can be obtained from X Y Z, and it is applied to the brushes B^1, B^2 and B^3. The voltage of this supply will depend on the position of the rotor phases with respect to the stator phases, and it is therefore adjustable by moving the rotor of the induction regulator.—*October 27th*, 1926.

TRANSFORMERS AND CONVERTERS.

251,299. April 26th, 1926.—IMPROVEMENTS IN OR RELATING TO COIL SUPPORTS FOR ELECTRIC TRANSFORMERS AND THE LIKE, *International General Electric Company, Inc., of* 120, *Broadway, New York.*

In the construction of transformers it is customary to provide cylindrical coils at both ends with rings of equal or approximately equal diameter of insulating material—for example, hard paper. By means of these rings the coil can be supported in a satisfactory way in the axial direction. The coil has great firmness in the axial direction, especially with circular cross section. It is only the fastening of the coil ends that presents any difficulty, as these ends have a tendency to spread apart under the influence of strong currents. This defect is over-

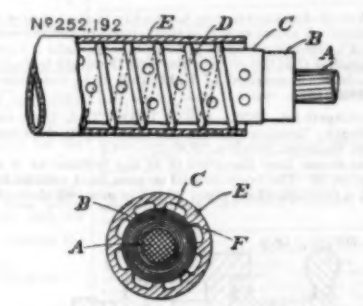


come according to this invention by providing the front surface of the cylinder with a groove into which the coil fits, and in order not to prevent the circulation of the cooling medium, the insulation ring is provided with openings on its periphery. The upper illustration is a cross section of a coil support and the lower end of the coil, and the bottom illustration a developed elevation of part of the support. A is the cylindrical coil, B the insulation ring. The extension C holds the end winding or several of the outermost windings in the radial direction. The coil can be held more securely by an internal extension D. From the lower illustration it can be seen how the openings for the cooling medium are formed. They can be hollowed out of the edge of the ring farthest away from the coil as at E or be made as holes F penetrating the wall of the ring.—*November 4th*, 1926.

TRANSMISSION OF POWER.

252,192. May 14th, 1926.—IMPROVEMENTS IN OR RELATING TO HIGH-TENSION ELECTRIC CABLES, Pirelli and Co., of Bicoca Works, near Milan, Italy.

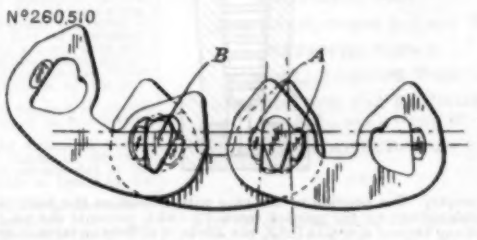
The illustrations shows the invention applied to a single-core cable, but the method of applying the invention to three core cables is also described. The conductor A is covered with insulation B, the surface of which is provided with a discontinuous metallic layer C, round which a spiral made of metallic or other material is wrapped. The discontinuous metallic layer C may consist of a metallic net or metallic wires or ribbons wound in



the form of a helix or a metallic plate provided with cuts and holes or a permeable plate, such as one of paper or textile material provided with a metallised surface. When the spiral wrapping D is not made of metallic material, the metallic layer C should be electrically connected at intervals with the lead sheath E. The spaces between the turns of the spiral wrapping D constitute a cavity which is filled with oil, and is not subject in its interior to electric stress. The insulation is protected by a lead sheath E, the inner surface of which is provided with ribs F, so as to form cavities for the oil.—*November 4th*, 1926.

260,510. March 25th, 1925.—TRANSMISSION CHAINS, The Coventry Chain Company, Ltd., and R. S. Cattanach, Gisborne, Stoney-road, Coventry.

The object of this invention is to make a toothed chain run



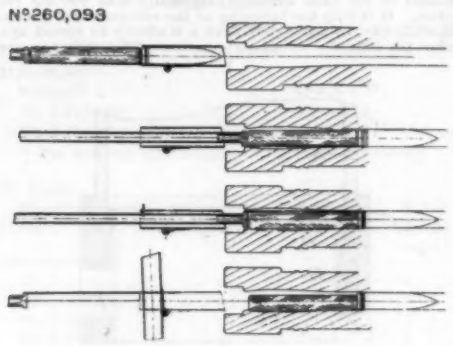
as silently as is possible, by momentarily shortening the pitch of the teeth just as they come into mesh with the sprocket wheels.

To this end the pin joints between adjacent links are made by means of three separate transverse pieces. There are two liners A A fixed to opposite links, and an intermediate rivet B of non-circular or ovoid form. The result is that as the chain bends round the sprocket wheel the liners roll on the rivet and bear against a smaller part of its diameter, so that the desired shortening of the pitch is effected. As the chain leaves the sprocket the reverse action takes place, and an easy release is effected.—*November 4th*, 1926

ORDNANCE AND ARMOUR.

260,093. October 8th, 1925.—Ramming Devices for Loading Guns, W. Beardmore and Co., Parkhead, Glasgow, and T. H. Webster.

The object of this invention is to arrange for the loading of a breech-loading gun in a single operation as follows:—The rammer being in loading position, the trough is loaded with the propellant charge and the rammer is given its ramming stroke so that in one advance movement it conveys the charge and at the same time pushes the projectile in front of it into the bore of the gun. When the projectile is seated in the rifling the advance

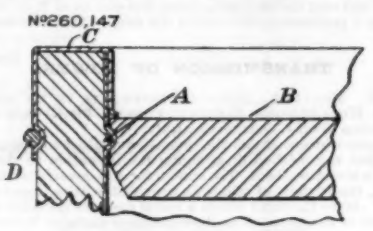


motion ceases. The rammer head with the trough on which the charge is lying is then given a semi-rotation on its axis and the charge is deposited therefrom on to the lower wall of the chamber of the gun. The rammer is then withdrawn, leaving the projectile and the charge within the bore of the gun. The breech can then be closed and the gun fired. When in fully retracted position the rammer head is reversely rotated into a position such that the trough can receive the next charge. The illustrations show the sequence of operations and how, at the end of the cycle, the loading tray is tipped into a vertical position to receive the next projectile from below.—*October 28th*, 1926.

MISCELLANEOUS.

260,147. February 16th, 1926.—Containers, E. C. R. Marks, 57, Lincoln's Inn-fields, London, W.C. 2.

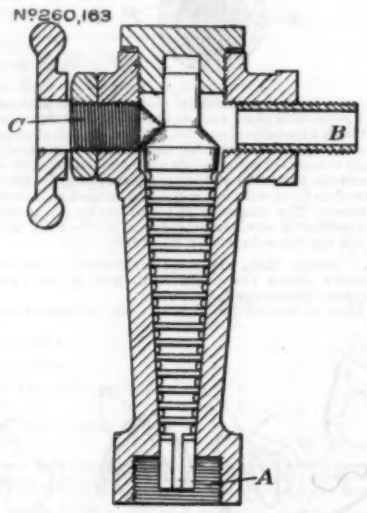
This invention is concerned with drums made of paper or similar material, used for containing chemicals. The ends of the drum are provided with a projecting beading A which fits into a corresponding groove in the head B. The head, it will be



seen, is bevelled so that it may be readily pushed into place over the beading. A metal ring C is then slipped over the end of the drum and a clamping ring D put in place to make a tight joint. It is suggested that the ends of the ring D should be fastened by welding, but the method of tightening it is not indicated.—*October 28th*, 1926.

260,163. April 1st, 1926.—Steam Traps, T. J. Lock and G. C. Springer, Newton Works, Macklin-street, Newton-street, High Holborn, London, W.C. 2.

In this steam trap the inlet is at the bottom at A and the discharge at B. The body, it will be seen, is of conical form and contains a corresponding plug, which is grooved throughout its



length. The position of the plug with respect to the body is determined by the pointed screw C, which prevents the plug rising beyond a certain limit, but allows it to drop on its seating and act as a non-return valve. It is said that the action of the grooves in the plug is such as to separate water from the steam and allow it to pass away by the outlet B.—*October 28th*, 1926.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Institute of Metals: Sheffield Local Section.—Applied Science Department of the University, St. George's-square, Sheffield. "The Conductivity of Silver Plating Solutions," by Mr. A. E. Nicol. 7.30 p.m.

Institute of Metals: Swansea Local Section.—Metallurgical Department, University College, Singleton Park, Swansea. "The Application of Metallographic Methods to Coal," by Mr. C. A. Seyler. 7.15 p.m.

Institution of Chemical Engineers.—Science Museum, South Kensington, London, S.W. 7. Conference. For programme see page 580.

Institution of Engineering Inspection.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "Portable Steel Structures of Large Span," by Major H. N. Wylie. 7.30 p.m.

Institution of Mechanical Engineers.—Storey's Gate, Westminster, London, S.W. 1. Fifth report of the Marine Oil Engine Trials Committee. 6 p.m.

Institution of Water Engineers.—Geological Society's Rooms, Burlington House, Piccadilly, London, W. 1. Winter general meeting. Papers: "Water Supply Finance," by Mr. A. W. Kenyon; "Recent Developments in the Design and Application of Centrifugal Pumps," by Mr. J. P. Hallam; "Repair Works in Connection with the Belmont Reservoir of the Bolton Corporation," by Mr. J. K. Swales; "The History of an Artesian Bore-hole," by Mr. E. J. Silcock. 10.30 a.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Lecturette, "A Method of Measuring Temperatures in the Cylinders of Internal Combustion Engines," by Mr. C. E. Foster. 7.30 p.m.

Keighley Association of Engineers.—Room 14, Temperance Institute, Keighley. Lecture, "Aeroplanes," by Mr. W. S. Shackleton. 7.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—Literary and Philosophical Society's rooms, Newcastle-upon-Tyne. "Workshop Methods in Heavy Engineering," by Messrs. H. J. Brackenbury and W. J. Guthrie. 6 p.m.

Physical Society.—Imperial College of Science, South Kensington, London, S.W. 7. Papers; "The Principle Governing the Distribution of Current in a System of Linear Conductors," by Dr. Frank Wenner; "A Capacitance Bridge of Wide Range and a New Inductometer," by Mr. Albert Campbell; a demonstration of "The Behaviour of Bodies with Non-conducting Surfaces in Electrostatic Fields" will be given by Mr. L. G. Vedy. 5 p.m.

Smithfield Club Show.—Royal Agricultural Hall, Islington, London, N. 1. 9 a.m.

SATURDAY, DECEMBER 11TH.

Institute of British Foundrymen: Lancashire Branch, Junior Section.—College of Technology, Sackville-street, Manchester. Lecture, "Cast Iron in Engineering," by Mr. E. L. Rhead. 7 p.m.

Institution of Civil Engineers.—Students' visit to reconstruction work at Piccadilly Circus Station.

Institution of Municipal and County Engineers.—Vestry Hall, Dawlish. South-Western District meeting. Paper, "Twenty Years in an Urban District," by Mr. S. F. C. Churchward. 2.15 p.m.

North of England Institute of Mining and Mechanical Engineers: Graduates' Section.—Neville Hall, Newcastle-upon-Tyne. Joint meeting with Graduates' Sections of other Institutions. Discussion on "The Production and Transport of Coal by Machinery." 3 p.m.

MONDAY, DECEMBER 13TH.

Bradford Engineering Society.—The Technical College, Bradford. Lecture, "Switzerland," by Mr. S. Gamble. 7.30 p.m.

Imperial College Association.—Hotel Cecil, Strand, London, W.C. 2. Annual dinner. 7.30 p.m.

Institute of Metals: Scottish Local Section.—Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. "Fescolising," by Mr. C. H. Faris; "Calorising," by Mr. N. C. Marples; and "Chromium Plating," by Mr. E. A. Ollard. 7.30 p.m.

Institution of Automobile Engineers.—Co-operative Old Hall, Derby. Derby Graduates' meeting. Exhibition of films of engineering interest. 7.30 p.m.

Institution of Mechanical Engineers.—Storey's-gate, Westminster, London, S.W. 1. Graduates' Section meeting. "Payment by Results," by Mr. E. H. Lewis. 7 p.m.

Railway Club.—25, Tothill-street, London, S.W. 1. Paper, "The Underground Railway," by Mr. W. H. R. Dawson. 7.30 p.m.

Society of Engineers.—Geological Society's Rooms, Burlington House, Piccadilly, London, W. 1. Paper, "The Economic Proportions and the Stresses in a Solid Masonry Dam or Buttress, subjected to Water Pressure Acting on an Inclined Face," by Professor F. Harvey Hummel. 5.45 p.m.

TUESDAY, DECEMBER 14TH.

Institute of British Foundrymen: Lancashire Branch, Burnley Section.—Municipal College, Ormerod-road, Burnley. Open discussion on short papers by Messrs. J. Hogg, W. H. Meadowcroft and F. Harris. 7.15 p.m.

Institute of Marine Engineers.—85–88, The Minories, Tower Hill, London, E. 1. Presidential address by Lord Kylsant of Carmarthen. 6.30 p.m.

Institution of Automobile Engineers: Coventry Centre.—Works of Armstrong-Siddeley Motors, Ltd., Parkside, Coventry. Lecture, "The L.G.O.C. Methods of Repairing Motor 'Buses," by Mr. G. Rushton. 7.30 p.m.

Institution of Civil Engineers.—Great George-street, London, S.W. 1. Paper, "The Remodelling of Charing Cross and Cannon-street Stations," by Mr. George Ellson. 6 p.m.

Institution of Electrical Engineers: Scottish Centre.—Electrical Engineering Lecture Room, 149, Royal Technical College, Glasgow. Paper, "The Design of City Distribution Systems and the Problem of Standardisation," by Messrs. J. R. Beard and T. G. N. Haldane. 7.30 p.m.

Institution of Petroleum Technologists.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "A Contribution to the Study of the Origin of Petroleum: The Berginisation of Fish Liver Oils and Other Bodies," by Dr. W. R. Ormandy, Professor I. M. Heilbron, Messrs. E. C. Craven and H. J. Channon. 5.30 p.m.

Manchester Geological and Mining Society.—Queen's Chambers, 5, John Dalton-street, Manchester. Paper, "Electrical Installations in Mines," by Mr. J. A. B. Horsley. 4 p.m.

North-East Coast Institution of Engineers and Shipbuilders: Middlesbrough Branch.—Cleveland Scientific and Technical Institution, Corporation-road, Middlesbrough. "Technical Education," by Mr. W. J. Williams. 7.30 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. "The Imperfect Crystallisation of Common Things," by Sir William Bragg. 5.15 p.m.

Society of Glass Technology.—Visit to the milk bottling plant of United Dairies, Ltd., at Streatham.

WEDNESDAY, DECEMBER 15TH.

British Cast Iron Research Association.—Hotel Cecil, Strand, London, W.C. 2. Annual general meeting and luncheon. 12.15 p.m.

Electroplaters' and Depositors' Technical Society.—Northampton Polytechnic Institute, St. John-street, London, E.C. 1. "Acidity of Certain Plating Solutions," by Mr. A. W. Hothersall. 8.15 p.m.

Institution of Automobile Engineers.—Chamber of Commerce, New-street, Birmingham. Graduates' meeting. Paper, "Works Organisation," by Mr. H. Warner. 7.30 p.m.

Institution of Automobile Engineers: North of England Centre.—The Engineers' Club, Albert-square, Manchester. Paper, "Radiator Design," by Mr. F. Randle. 7 p.m.

Institution of Civil Engineers.—Great George-street, London, S.W. 1. Students' meeting. Paper, "Some Applications and Advantages of Town Gas," by Mr. J. G. Kimber. 6.30 p.m.

Newcomen Society.—Prince Henry's Room, 17, Fleet-street, London, E.C. 4. Papers: "Christofer Polhem, the 'Archimedes of the North,'" by Mr. J. G. A. Rhodin; and "Martin Triewald and the First Steam Engine in Sweden," by Mr. A. Waerland. 5.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—Bolbec Hall, Newcastle-upon-Tyne. Graduate Section meeting. "Some Problems of the Locomotive," by Mr. L. P. Tappin. 7.15 p.m.

Royal Meteorological Society.—49, Cromwell-road, South Kensington, London, S.W. 7. Papers, "Some Meteorological Observations made at Sea," by Mr. N. K. Johnson; "Some Measurements of Temperatures Near the Surface in Various Kinds of Soils," by Messrs. N. K. Johnson and E. L. Davies; "Investigation on the Behaviour of Hair Hygrometers," by Dr. A. N. Puri. 5 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. "Some Aspects of the Chemical Industry," by Mr. W. J. U. Woolcock. 8 p.m.

Society of Glass Technology.—University College, Gower-street, London, W.C. 1. Papers: "Some Corrosion and Erosion Phenomena and their Bearing on the Macrostructure of Refractories," by Messrs. J. F. Hyslop, R. Gumm and H. Biggs; "A Note on the X-ray Patterns of Mullite and Sillimanite," by Messrs. J. F. Hyslop and H. P. Rooksby; "Further Note on Sillimanite as a Glass Works Refractory," by Professor W. E. S. Turner; "The Viscous Properties of Glass," by Mr. Vaughan H. Stott; "The Effect of Cullet on the Melting of Glass," by Professor W. E. S. Turner; "The Design of Parison Moulds," by Dr. S. English. 2.30 p.m.

THURSDAY, DECEMBER 16TH.

Institute of Metals: Birmingham Local Section.—The Engineers' Club, Waterloo-street, Birmingham. "Hardening," by Dr. W. Rosenhain. 7 p.m.

Institution of Automobile Engineers.—Watergate House, Adelphi, London, W.C 2. Graduates' meeting. Paper, "Factors Affecting Internal Combustion," by Mr. C. I. Kelly. 7.30 p.m.

Institution of Automobile Engineers.—Castle-street Hall, Luton. Luton Graduates' meeting. Exhibition of films of engineering interest. 8 p.m.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, London, W.C. 2. Paper, "Notes on the 60,000-Volt Underground Network of the Union d'Electricité," by Colonel E. Mercier. 6 p.m.

Institution of Mechanical Engineers: Midland Branch.—Midland Institute, Birmingham. Thomas Hawksley Lecture, "Elasticity and Plasticity," by Professor E. G. Coker. 7 p.m.

Institution of Mechanical Engineers: Yorkshire Branch.—Hotel Metropole, Leeds. Address on "Efficiency," by the Chairman, Mr. J. H. Barker. 7.30 p.m.

Institution of Mining and Metallurgy.—Geological Society's Rooms, Burlington House, Piccadilly, London, W. 1. Papers, "The Internal Combustion Engine: Some Modern Types and their Application to Mining," by Mr. W. A. Macleod; "A Method for Grading Variable Ores," by Mr. W. F. Smeeth; "Discovery of Tourmaline in a Norwegian Pyrites Deposit," by Mr. H. H. Smith. 5.30 p.m.

Institution of Welding Engineers.—Caxton Hall, Westminster, London, S.W. 1. Paper, "Some Features in the Path of a Crack," by Dr. G. H. Gulliver. 8 p.m.

FRIDAY, DECEMBER 17TH.

Institute of Metals: Sheffield Local Section.—Mappin Hall, St. George's-square, Sheffield. "The Influence of Sulphur in Cast Iron," by Mr. J. E. Hurst. 7.30 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Paper, "Progress Methods Employed in a Large Mass Production Motor Works," by Mr. H. D. Glover. 7.30 p.m.

SATURDAY, DECEMBER 18TH.

Institution of Automobile Engineers.—London Graduates' visit to the works of Truman, Hanbury and Buxton, Ltd., Spitalfields, E. 1. 2.30 p.m.

Institution of Civil Engineers.—Students' visit to the surveying instrument works of E. R. Watts and Son, Ltd., Camberwell.

TUESDAY, DECEMBER 21ST.

Institution of Engineers and Shipbuilders in Scotland.—39, Elmbank-crescent, Glasgow. Paper, "High Elastic Limit Steel for Shipbuilding and Marine Work," by Mr. T. M. Service. 7.30 p.m.

WEDNESDAY, DECEMBER 22ND.

Crystal Palace School of Practical Engineering.—London, S.E. 19. Award of certificates by Sir W. H. Ellis. 3 p.m.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

The Premier Cooler and Engineering Company, Ltd., of Shalford, near Guildford, asks us to announce that Mr. A. B. Cleworth has entered its service to take charge of the sales of humidifying and ventilating plant.